2018 CALIFORNIA STATE RAIL PLAN

Technical Appendix

Appendix A

September 2018

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Appendix A.1 Existing Rail System

Existing and Proposed Passenger Rail Lines, Corridors, and Services

Intercity Passenger Rail Services

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Amtrak Thruway Bus Network

An extensive network of dedicated Amtrak Thruway buses supports intercity passenger rail by providing dedicated connecting service to markets without direct passenger rail service. Amtrak Thruway buses offer connections between the *Pacific Surfliner* in the south and the *San Joaquin* and *Capitol Corridor* routes in the north, providing access to dozens of communities between.

Additional bus routes serve destinations from McKinleyville and Redding in the north, to Coachella Valley and San Diego in the south, and Reno and Las Vegas in the east. Amtrak Thruway buses provide connections to many popular destinations in California, including Yosemite National Park, Napa Valley, Palm Springs, Lake Tahoe, and the Monterey Bay. Amtrak Thruway bus service is extended only to passengers who transfer directly to/from either State-supported or Amtrak long-distance rail routes.

Ownership and Track Characteristics[1]

The ownership and track characteristics are shown in Table A.1 for the *San Joaquin* route; Table A.2 for the *Capitol Corridor* route; and Table A.3 for the *Pacific Surfliner* route.

[1] Caltrans, *2013 California State Rail Plan*, 2013.
Notes: SJJPA provided updated information for the *San Joaquin* since the 2013 Rail Plan. LOSSAN confirmed that the information on the *Pacific Surfliner* from the 2013 Rail Plan is still current.

Table A.1: San Joaquin Route Ownership and Track Characteristics

SAN JOAQUINS ROUTE OWNERSHIP AND TRACK CHARACTERISTICS								
Between	Mile Post	And	Mile Post	Miles	Owner of Track	No. of Tracks*	Max. Speed*	Signal System
Oakland Jack London Square	7.0	Oakland 10th St	4.2	2.8	UPRR	2	50	CTC
Oakland 10th St	2.2	Martinez	31.6	29.4	UPRR	2	79	CTC
Martinez	31.6	Port Chicago	40.8	6.1	UPRR	1	79	CTC
Port Chicago	1163.5	Sacramento	1121.1	42.4	BNSF	1-2	79	CTC
Sacramento	89.1	Elvas	91.7	2.6	UPRR	2	35	CTC
Elvas	38.9	Stockton	84.1	45.2	UPRR	1	60	CTC
Stockton	1121.1	Bakersfield	886.9	234.2	BNSF	1	79	CTC
Total				362.7				
*Number of Tracks = General number of mainline tracks; does not include sidings or very short sections of 2nd main track.								
*Maximum Speed = Primary maximum passenger speed (not necessarily continuous) w ithin indicated section of main line.								
Ow ners:								
BNSF - The BNSF Railw ay Company								
UPRR - Union Pacific Railroad Company								
Signal Systems:								
CTC - Centralized Traffic Control - Wayside signals protect possession of blocks and grant authority for train movements. Signals and pow ered sw itches are remotely controlled from the dispatching center.								

Table A.2: Capitol Corridor Route Ownership and Track Characteristics

CAPITOL CORRIDOR ROUTE OWNERSHIP AND TRACK CHARACTERISTICS								
Between	**Mile Post**	**And**	**Mile Post**	**Miles**	**Owner of Track**	**No. of Tracks***	**Max. Speed***	**Signal System**
Auburn	124.3	Rocklin	110.5	13.8	UPRR	1	50	ABS/CTC
Rocklin	110.5	Roseville	106.4	4.1	UPRR	2	40	CTC
Roseville	106.4	Elvas	91.8	14.6	UPRR	2	79	CTC
Elvas	91.8	Sacramento	88.9	2.9	UPRR	2	35	CTC
Sacramento	88.9	Sacramento River	88.5	0.4	UPRR	2	20	CTC
Sacramento River	88.5	Davis	75.4	13.1	UPRR	2	79	CTC
Davis	75.4	Martinez	31.7	43.7	UPRR	2	79	CTC
Martinez	31.7	Oakland 10th St	4.2	29.5	UPRR	2	79	CTC
Oakland 10th St	4.2	Oakland Jack London Square	7.0	2.8	UPRR	2	50	CTC
Oakland Jack London Square	7.0	North Elmhurst	13.5	6.5	UPRR	2	79	CTC
North Elmhurst	13.5	Niles Junction	29.7	16.2	UPRR	1	79	CTC
Niles Junction	29.7	Newark	31.0	5.2	UPRR	2	79	CTC
Newark	31.0	Santa Clara	44.7	13.7	UPRR	1	70	CTC
Santa Clara	44.7	San Jose	47.5	2.8	PCJPB	3	40	CTC
Total (**includes rand trip between Union Station and Mission Tower)				169.3				
*Number of Tracks = General number of mainline tracks; does not include sidings or very short sections of 2nd main track.								
*Maximum Speed = Primary maximum passenger speed (not necessarily continuous) w ithin indicated section of main line.								
Ow ners:								
BNSF - The BNSF Railw ay Company								
PCJPB - Peninsula Corridor Joint Pow ers Board								
Signal Systems:								
ABS - Automatic Block Signals - Wayside signals protect possession of block by indicating w hether the track ahead is clear. The signals do not grant authority for train movements.								
CTC - Centralized Traffic Control - Wayside signals protect possession of blocks and grant authority for train movements. Signals and pow ered sw itches are remotely controlled from the dispatching center.								

Table A.3: Pacific Surfliner Route Ownership and Track Characteristics

PACIFIC SURFLINER ROUTE OWNERSHIP AND TRACK CHARACTERISTICS								
Between	**Mile Post**	**And**	**Mile Post**	**Miles**	**Owner of Track**	**No. of Tracks***	**Max. Speed***	**Signal System**
San Luis Obispo	248.7	South San Luis Obispo	251.4	2.8	UPRR	2	60	CTC
South San Luis Obispo	251.4	Ellwood	355.8	104.3	UPRR	1	70	TWC/ABS
Ellwood	355.8	North Santa Barbara	365.0	9.2	UPRR	1	79	CTC
North Santa Barbara	365.0	South Santa Barbara	368.6	3.6	UPRR	2	45	CTC
South Santa Barbara	368.6	Los Posas (west of Moorpark)	423.1	54.5	UPRR	1	70	CTC
Los Posas (west of Moorpark)	426.4	Ventura/Los Angeles county line	442.0	15.6	(a)UPRR/VCTC	1	70	CTC
Ventura/Los Angeles county line	442.0	Rayner (west of Van Nuys)	453.1	11.1	(a)UPRR/LACMTA	1	70	CTC
Raymer (west of Van Nuys)	453.1	Burbank Jct (milepost equation)	462.6	9.5	(a)UPRR/LACMTA	2	70	CTC
Burbank Jct. (milepost equation)	11.3	Glendale (CP Fletcher Drive)	4.8	6.5	(a)UPRR/LACMTA	2	79	CTC
Glendale (CP Fletcher Drive)	4.8	CP Dayton	2.2	2.6	LACMTA	2	79	CTC
CP Dayton (b)	2.2	Mission Tower	0.7	1.5	LACMTA	2	50	CTC
Mission Tower	0.7	L.A. Union Station	0.0	1.4	LACMTA	5	25	CTC
Mission Tower	0.7	CP San Diego Jct. (mp equation)	0.9	0.2	LACMTA	2	25	CTC
CP San Diego Jct. (mp equation)	140.2	Soto (east of Redondo Jet)	144.4	4.2	LACMTA	2	79	CTC
Soto (east of Redondo Jct)	144.4	Bancini (west of Pico Rivera)	149.8	5.4	BNSF	3	79	CTC
Bandini (west of Pico Rivera)	149.8	Buena Park	160.3	10.5	BNSF	2	79	CTC
Buena Park	160.3	Fullerton Jct.	165.5	5.2	BNSF	3	79	CTC
Fullerton Jct.	165.0	Santa Ana	175.2	9.7	OCTA	2	79	CTC
Santa Ana	175.2	Laguna Niguel	193.7	18.5	OCTA	2	90	CTC/ATS
Laguna Niguel	193.7	San Juan Capistrano	197.2	3.5	OCTA	1	90	CTC/ATS
San Juan Capistrano	197.2	Orange/San Diego County Line	207.4	10.2	OCTA	1	40	CTC/ATS
Orange/San Diego County Line	207.4	Del Mar/San Diego City Limits	245.6	38.2	NCTD	2	90	CTC/ATS
Del Mar/San Diego City Limits	245.6	CP Cumbres (Miramar Road)	252.9	7.3	SDMTS	2	90	CTC/ATS
CP Cumbres (Miramar Road)	252.9	CP Elvira	257.9	5.0	SDMTS	2	50	CTC
CP Elvira	257.9	Old Town	264.2	6.3	SDMTS	2	75	CTC
Old Town	264.2	San Diego	267.6	3.4	SDMTS	1	60	CTC
Total (**includes round trip between Union Station and Mission Tower)				351.6				

*Number of Tracks = General number of mainline tracks; does not include sidings or very short sections of 2nd main track.

*Maximum Speed = Primary maximum passenger speed (not necessarily continuous) w ithin indicated section of main line.

(a)On these segments VCTC and LACMTA purchased a 40 foot w ide portion of UPRR's right -of-w ay. Betw een Raymer and Burbank Junction, LACMTA constructed and ow ns the second man line track.

(b)Via West Side of Los Angeles River (Dow ney Avenue Bridge)

Ow ners:

BNSF - The BNSF Railw ay Company

LACMTA - Los Angeles County Metropolitan Transportation Authority

NCTD - North County Transit District

OCTA - OCTA

SDMTS - San Diego Metropolitan Transit System

UPRR - Union Pacific Railroad Company

VCTC - Ventura County Transportation Commission

Signal Systems:

ABS - Automatic Block Signals - Wayside signals protect possession of block by indicating w hether the track ahead is clear. The signals do not grant authority for train movements.

ATS - Automatic Train Stop - An overlay system that allow s speeds of 90 mph. System automatically applies train brakes if a restrictive signal indication is not observed a w arning alarm is not acknow ledged.

CTC - Centralized Traffic Control - Wayside signals protect possession of blocks and grant authority for train movements. Signals and pow ered sw itches are remotely controlled from the dispatching center.

TWC - Track Warrant Control - Dispatching center gives authority for train movement by radio to train crew directly. (On some railroads this is identified as Direct Traffic Control, or DTC.)

Amtrak Thruway Bus Maps

Maps of the Amtrak Thruway Bus routes are shown on Exhibit A.1 for Southern California; Exhibit A.2 for Central California; and Exhibit A.3 for Northern California.

Exhibit A.1: Amtrak Thruway Bus Service (Southern California)

Exhibit A.2: Amtrak Thruway Bus Service (Central California)

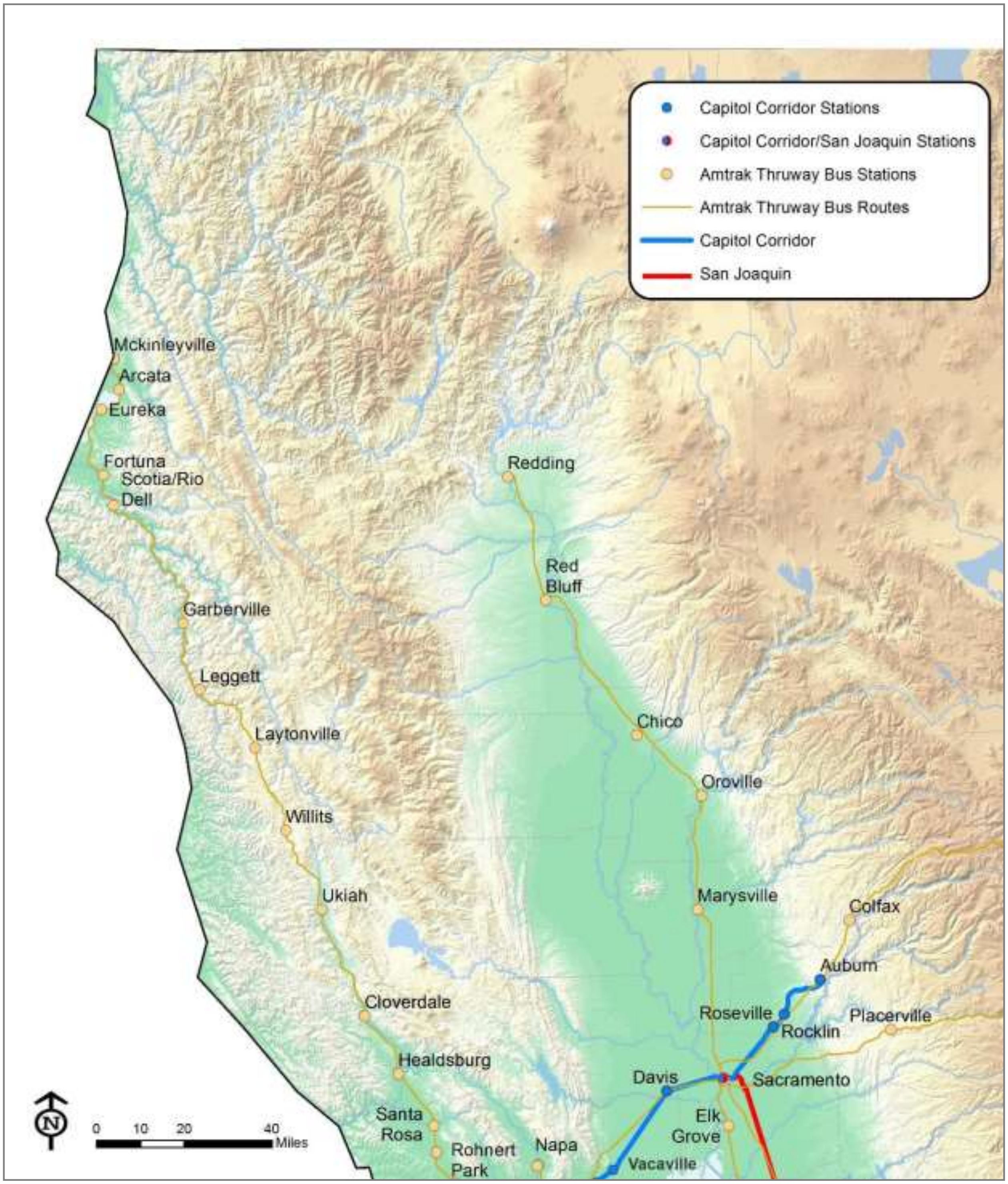


Exhibit A.3: Amtrak Thruway Bus Service (Northern California)

Table A.4: State-Supported Intercity Passenger Rail Agency Roles and Responsibilities

	Pacific Surfliner	San Joaquin	Capitol Corridor
Governance			
Management, Planning	Los Angeles–San Diego–San Luis Obispo Rail Corridor Agency (LOSSAN)	San Joaquin Joint Powers Authority (SJJPA)	Capitol Corridor Joint Powers Authority (CCJPA)
Comprehensive Rail System Planning	Caltrans	Caltrans	Caltrans
Operations	Amtrak	Amtrak	Amtrak
Oversight	Caltrans	Caltrans	Caltrans
Funding			
Operating funding	Caltrans	Caltrans	Caltrans
Capital funding	Caltrans, Federal and local agencies	Caltrans, Federal and local agencies	Caltrans, Federal and local agencies
Equipment			
Equipment Ownership	Amtrak and Caltrans	Primarily Caltrans	Primarily Caltrans
Maintenance	Amtrak	Amtrak with oversight from CCJPA and SJJPA	Amtrak with oversight from CCJPA
Track Ownership	UPRR, Ventura County Transportation Commission, Los Angeles County Metropolitan Transportation Authority, BNSF, Orange County Transportation Authority, North County Transit District (NCTD), San Diego Metropolitan Transit System	UPRR, BNSF	UPRR, Peninsula Corridor Joint Powers Board (PCJPB)

Sources: Amtrak, *About Amtrak California*, accessed 2016; Caltrans, *2013 California State Rail Plan* (2013); LOSSAN Rail Corridor Agency, *Business Plan FY 2016-17 – FY 2017-18*, 2016. Accessed 2016.

Commuter Rail

Connecting Services

Caltrain

Caltrain has a direct connection with other major public transportation operators on its route at various multimodal facilities. These operators include San Francisco Municipal Transportation Agency (Muni) light rail and buses, BART, SamTrans, Santa Clara VTA light rail and buses, Alameda-Contra Costa Transit District (AC Transit), the Dumbarton Express bus, and ACE (commuter service from Stockton to San Jose). ACE shares a terminal with Caltrain at San Jose Diridon Station.

Caltrain connects directly with the intercity *Capitol Corridor* and Amtrak's long-distance *Coast Starlight* at the San Jose Diridon Station. Amtrak *San Joaquin* and *Capitol Corridor* route feeder bus stops are located at the Caltrain station in San Francisco. Local transit services link many Caltrain stations to key city destinations and employment centers. For example, the San Jose Diridon station is served by multiple Santa Clara VTA bus lines, along with Monterey–Salinas Transit buses and Highway 17 Express bus service to Santa Cruz. In addition, a variety of shuttles connect Caltrain stations to major employment sites on the San Francisco Peninsula. Some shuttles are partially sponsored by Caltrain, and are free and open to the public; while others are privately operated.

ACE

Bus and rail transit connections and dedicated shuttles are an integral part of the ACE system, providing a seamless commuting link between stations and workplaces. All stations have some form of connecting transit. In addition, four stations have direct connections to rail services. The Stockton station has connections to *San Joaquin* trains. At the Great America station, connections can be made with Santa Clara VTA light rail and buses (approximately 750 feet east of the station) and the *Capitol Corridor*. At Santa Clara, connections can be made with Caltrain and the *Capitol Corridor*; and at San Jose, connections can be made with Caltrain, the *Capitol Corridor*, the Amtrak *Coast Starlight*, and Santa Clara VTA light rail and buses.

Metrolink

Each county has a transit plan to ensure integration of Metrolink service with other transit systems and transportation modes. The Metrolink fare is designed to provide a free transfer, either from feeder bus or to local transit at the destination station. Metrolink passengers can connect with Amtrak trains at Anaheim, Burbank Bob Hope Airport, Camarillo, Chatsworth, Fullerton, Glendale, Irvine, Moorpark, Oceanside, Oxnard, San Clemente Pier, San Juan Capistrano, Santa Ana, Simi Valley, and Van Nuys. Metrolink passengers can connect to the

Metro Red Line/Purple Line subway and the Metro Gold Line light rail at Los Angeles Union Station (LAUS), to the Metro Green Line at Norwalk (via Norwalk Transit Route 4), to the Metro Blue Line and the Metro Expo Line at the 7th Street/Metro station, and to the Metro Orange Line at Chatsworth station, all at no additional charge.

Shuttle service connects the Downtown Burbank and Burbank-Bob Hope Airport stations to the Burbank Bob Hope Airport terminal. LAUS connects to the State-supported *San Joaquin* route in Bakersfield via Amtrak Thruway bus service. In addition, it also connects to Amtrak long-distance trains, such as the *Sunset Limited*, *Southwest Chief*, *and Coast Starlight*. LAUS also provides connections with various local and city bus and shuttle services, including direct FlyAway shuttle service to the Los Angeles International Airport.

Recent light-rail additions, including the Metro Exposition Line to Santa Monica (reachable from LAUS via the Red or Purple Lines) and the Metro Gold Line Foothill Extension to Azusa, allow Metrolink passengers to travel to additional areas.

Table A.5: Metrolink Lines and Service Areas[2]

Line	Service Area	Approximate Running Time
Ventura County Line	East Ventura, Oxnard, Camarillo, Moorpark, Simi Valley, Chatsworth, Northridge, Van Nuys, Burbank Bob Hope Airport, Downtown Burbank, Glendale, Los Angeles.	Trains operate between East Ventura and Los Angeles from 5:00 AM to 9:00 PM.
Antelope Valley Line	Lancaster, Palmdale, Vincent Grade/Acton, Via Princessa, Santa Clarita, Newhall, Sylmar/San Fernando, Sun Valley, Downtown Burbank, Glendale, Los Angeles.	Trains operate between Lancaster and Los Angeles from 3:30 AM and 12 AM.
San Bernardino Line	San Bernardino, Rialto, Fontana, Rancho Cucamonga, Upland, Montclair, Claremont, Pomona (North), Covina, Baldwin Park, El Monte, Cal State L.A., Los Angeles.	Trains operate between San Bernardino and Los Angeles from 3:30 AM to 11:30 PM.
Riverside Line	Riverside Downtown, Pedley, East Ontario, Downtown Pomona, Industry, Montebello/Commerce, Los Angeles.	Trains operate between San Bernardino and Los Angeles from 4:30 AM to 8:00 PM. Weekdays only.

[2] Metrolink, *Timetable*, 2016. Accessed 2017.

Line	Service Area	Approximate Running Time
Orange County Line	Oceanside, San Clemente Pier, San Clemente, San Juan Capistrano, Laguna Niguel/Mission Viejo, Irvine, Tustin, Santa Ana, Orange, Anaheim, Fullerton, Buena Park, Norwalk/Santa Fe Springs, Commerce, Los Angeles.	Trains operate between Oceanside and Los Angeles from 4:30 AM to 12:00 AM.
Inland Empire-Orange County Line	San Bernardino, Riverside Downtown, Riverside La Sierra, North Main Corona, West Corona, Anaheim Canyon, Orange, Santa Ana, Tustin, Irvine, Laguna Niguel/Mission Viejo, San Juan Capistrano, San Clemente, San Clemente Pier, Oceanside.	Trains operate between San Bernardino and Oceanside from 4:30 AM to 8:30 PM.
91 Line	South Perris, Downtown Perris, Moreno Valley / March Field, Riverside Downtown, Riverside La Sierra, North Main Corona, West Corona, Fullerton, Buena Park, Norwalk/Santa Fe Springs, Los Angeles.	Trains operate between South Perris and Los Angeles from 4:30 AM to 8:30 PM.

COASTER

All COASTER stations have connecting transit services available. COASTER passengers can connect with Amtrak trains at Oceanside, Solana Beach, Old Town Station, and the downtown Santa Fe Depot in San Diego. At Oceanside Transit Center, connections are available to Metrolink commuter service to Los Angeles and to North County Transit District's (NCTD's) SPRINTER light-rail service to Escondido via Vista and San Marcos. Other stations have connections to San Diego Transit and San Diego Trolley. Passengers can connect to San Diego State University at the Old Town Transit Center via the San Diego Trolley's Green Line, and bus service from Santa Fe Depot to the San Diego International Airport. Transit connections in northern San Diego County are provided by NCTD BREEZE buses, including several services branded as "COASTER Connection" routes that provide peak-hour commute shuttle service to COASTER stations in the Sorrento Valley.

All Passenger Intermodal Facilities

Table A.6: Rail and Thruway Bus Connections to Airports[3]

Airport	Rail Corridor	Station	Public Transit Connection between Rail Station and Airport
Arcata-Eureka	*San Joaquin* Bus	McKinleyville	No connection. Bus stops at terminal.
Burbank Bob Hope	*Pacific Surfliner*, *Coast Starlight*, Metrolink (Ventura County Line)	Burbank – Airport Station	Regional Intermodal Transportation Center (RITC) is within walking distance of main terminal (shuttle also available)
Fresno-Yosemite International	*San Joaquin*	Fresno	Fresno Area Express
John Wayne	*Pacific Surfliner*	Santa Ana	OCTA
	Metrolink (Orange County/ Inland Empire Lines)	Tustin	iShuttle
Long Beach	*San Joaquin* bus	Long Beach	Long Beach Transit
Los Angeles International	*Pacific Surfliner, Coast Starlight*, Metrolink	Los Angeles Union Station	LAX Flyaway bus shuttle
	San Joaquin Bus	Van Nuys Flyaway	LAX Flyaway bus shuttle
San Jose Mineta International	*Capitol Corridor, ACE,* Caltrain	Santa Clara	VTA Airport Flyer
Oakland International	*Capitol Corridor*	Oakland Coliseum	Oakland Airport Connector
	BART	Coliseum/Oakland Airport	Oakland Airport Connector
	San Joaquin	Richmond	BART
Ontario International	*San Joaquin* Bus	Ontario	Omnitrans
	Metrolink	East Ontario, Fontana	Omnitrans

[3] Cambridge Systematics, Inc., 2016.

Airport	Rail Corridor	Station	Public Transit Connection between Rail Station and Airport
Palm Springs	*San Joaquin* Bus	Palm Springs	No connection. Bus stops at terminal.
San Diego International	*Pacific Surfliner*, COASTER	Santa Fe Depot	SDMTS
San Francisco International	BART	San Francisco International Airport	AirTrain
	Caltrain	Millbrae	BART

[a] Thruway bus services listed provide airport connections from Amtrak stations

Sonoma-Marin Area Rail Transit (SMART)

Feeder bus and shuttle services connect to multiple SMART stations. The northern terminus of the Phase 1 line is at Sonoma County Airport (extended to Windsor in the near term). Phase 2 – South will extend to Larkspur Ferry, which services San Francisco.[4]

Table A.7: Commuter Rail Services

Name	Route	Primary Administrator	Administration of Key Functions
Altamont Commuter Express (ACE)	Stockton–San Jose	San Joaquin Regional Rail Commission (SJRRC)	Operations and equipment maintenance: Herzog Transit Services Track ownership: UPRR is primary track owner. PCJPB owns track between Santa Clara and San Jose.
Caltrain	San Francisco–Gilroy	Peninsula Corridor Joint Powers Board (PCJPB)	Managing agency, including planning: San Mateo County Transit District Operations and equipment maintenance: TransitAmerica Services Track ownership: Counties, UPRR
COASTER	Oceanside -San Diego	North County Transit District (NCTD)	Operations and equipment maintenance: Bombardier Track Ownership: San Diego Metropolitan Transit System joint track owner within San Diego (NCTD owns

[4] Sonoma-Marin Area Rail Transit, *What is SMART?*, 2016. Accessed 2016.

Name	Route	Primary Administrator	Administration of Key Functions
			other portions)
Metrolink	Multiple routes in Los Angeles, Ventura, San Bernardino, Riverside, Orange, San Diego Counties	Southern California Regional Rail Authority (SCRRA)	Operations: Amtrak Bombardier: Equipment maintenance Track ownership: SCRRA Member Agencies, BNSF, UPRR, NCTD
Sonoma-Marin Area Rail Transit District (SMART)	Santa Rosa to San Rafael (2017) and potential expansion to Cloverdale and Larkspur at a later date	SMART District	Contracted Operations / Maintenance

Sources: Caltrain, *Joint Powers Agreement Peninsula Corridor Project*, 1996, accessed 2016; Caltrain, Caltrain Board Approves TransitAmerica to Run Train System (2011), accessed 2016; ACE, History of ACE, accessed 2016; North County Transit District, *Comprehensive Strategic, Operating, and Capital Plan FY 2017 – FY* 2026 (2016), accessed 2016; Metrolink, About Us, accessed 2016 SCRRA, Contract No. OP137-17 (2016), accessed 2016, http://metrolink.granicus.com/DocumentViewer.php?file=metrolink_f5361c74f445ce4300fbfd0f04e15fb0.pdf&view=1.

Existing Passenger Rail Performance

This section presents performance information for the three State-supported intercity passenger rail routes.

State-Supported Passenger Rail System Performance

- Table A.8, Table A.9 and Table A.10 provide route-specific performance for the *Pacific Surfliner*, *San Joaquin*, and *Capitol Corridor*, respectively.

Table A.8: *Pacific Surfliner* Route Performance

Performance Measure	Actual							
	FFY 08	FFY 09	FFY 10	FFY 11	FFY 12	FFY 13	FFY 14	FFY 15
Total Annual Revenue (in Millions of Dollars)	$53.2	$48.4	$51.2	$57.6	$61.55	$66.26	$70.40	$75.84
Total Annual Expenses (in Millions of Dollars)	$88.5	$86.6	$95.7	$99.7	$104.07	$105.38	$102.73	$114.22
Revenue – State Portion[a] (in Millions of Dollars)	$38.3	$34.9	$35.8	$40.3	$43.08	$46.38	$49.28	$53.09
Expenses – State Portion (in Millions of Dollars)	$63.0	$61.6	$67.0	$69.8	$72.88	$73.76	$71.91	$79.95
Farebox Ratio – State Portion	60.8%	56.6%	53.5%	57.7%	59.1%	62.9%	68.5%	66.4%
Annual State Costs[b] (in Millions of Dollars)	$24.7	$26.8	$31.2	$29.6	$29.79	$27.39	$32.32	$38.39
State Costs – Administration (in Millions of Dollars)	$1.5	$1.5	$1.5	$1.5	$1.50	$1.50	$1.50	$1.50
State Costs – Marketing (in Millions of Dollars)	$2.3	$2.3	$2.3	$2.3	$2.30	$2.30	$2.30	$2.30
State Cost per Passenger	$12.18	$14.75	$17.05	$15.16	$16.12	$14.49	$12.05	$13.58
State Cost per Passenger Mile	$0.15	$0.18	$0.21	$0.18	$0.19	$0.17	$0.22	$0.22
State Cost per Train Mile	$21.89	$23.35	$27.86	$26.38	$27.31	$24.49	$31.37	$34.29
Annual Ridership – Total Route	2,898,859	2,592,996	2,613,604	2,786,972	2,640,342	2,700,806	2,681,173	2,827,134
Annual Passenger Miles – Total Route	240,761,326	213,655,854	215,640,101	230,759,084	223,501,233	232,275,532	205,497,275	246,451,396

Performance Measure	Actual							
	FFY 08	FFY 09	FFY 10	FFY 11	FFY 12	FFY 13	FFY 14	FFY 15
Annual Train Miles – Total Route	1,612,497	1,638,188	1,599,515	1,601,816	1,558,015	1,597,429	1,471,731	1,599,430
On-Time Performance	76.1%	83.1%	76.3%	77.5%	75.5%	84.8%	77.0%	77.9%
Frequency (Daily Round Trips)								
San Diego-Los Angeles[c]	11	11	11	11	11	11	11	11
Los Angeles-Goleta	5	5	5	5	5	5	5	5
Goleta-San Luis Obispo	2	2	2	2	2	2	2	2

Source: Caltrans rail operational database.
Note: This table is intended to satisfy the performance evaluation requirements of AB 528.
[a] State portion measures of revenue, expenses, and farebox ratio reflect the 70 percent of the route that is State supported.
[b] State costs do not include equipment lease costs, and may include minor capital project costs.
[c] One additional weekend round trip.

Table A.9: *San Joaquin* Route Performance

Performance Measure	Actual							
	FFY 08	FFY 09	FFY 10	FFY 11	FFY 12	FFY 13	FFY 14	FFY 15
Annual Revenue (in Millions of Dollars)	$31.3	$29.6	$33.2	$37.8	$41.09	$41.83	$41.22	$40.46
Total Annual Expenses (in Millions of Dollars)	$68.3	$65.1	$67.8	$69.8	$73.09	$73.26	$81.86	$80.02
Farebox Ratio	45.8%	45.5%	48.9%	54.2%	56.2%	57.1%	50.4%	50.6%
Annual State Costs[a] (in Millions of Dollars)	$37.1	$35.5	$33.6	$32.0	$32.00	$31.43	$40.64	$39.56
State Costs–Administration (in Millions of Dollars)	$1.3	$1.3	$1.3	$1.3	$1.30	$1.30	$1.30	$1.30
State Costs – Marketing (in Millions of Dollars)	$1.5	$1.5	$1.5	$1.5	$1.50	$1.50	$1.50	$1.50
State Cost per Passenger	$39.03	$38.17	$34.36	$29.96	$27.96	$25.77	$34.20	$33.61
State Cost per Passenger Mile	$0.27	$0.27	$0.24	$0.20	$0.19	$0.18	$0.25	$0.24
State Cost per Train Mile	$27.78	$26.65	$25.26	$24.02	$23.93	$23.88	$30.45	$29.74
Annual Ridership	949,611	929,172	977,834	1,067,441	1,144,616	1,219,818	1,188,228	1,177,073
Annual Passenger Miles	139,004,634	133,711,704	139,405,193	156,427,566	166,336,873	170,076,164	165,538,347	164,249,895
Annual Train Miles	1,334,289	1,330,956	1,330,280	1,331,481	1,337,454	1,316,044	1,334,853	1,330,060
On-Time Performance	82.6%	89.6%	90.7%	89.5%	88.1%	77.7%	75.4%	73.4%
Frequency (Daily Round Trips)								
Oakland-Bakersfield[b]	4	4	4	4	4	4	4	4
Sacramento-Bakersfield	2	2	2	2	2	2	2	2

Source: Caltrans rail operational database. Note: This table is intended to satisfy the performance evaluation requirements o f AB 528.
[a] State costs do not include equipment lease costs, and may include minor capital project costs.
[b] Starting in June 2016, the San Joaquin began offering 5 Oakland -Bakersfield round trips per day.

Table A.10: *Capitol Corridor* Route Performance

Performance Measure	FFY 08	FFY 09	FFY 10	FFY 11	FFY 12	FFY 13	FFY 14	FFY 15
	Actual							
Annual Revenue (in Millions of Dollars)	$23.8	$23.5	$24.2	$27.1	$29.49	$29.20	$29.23	$30.09
Total Annual Expenses (in Millions of Dollars)	$53.3	$51.0	$53.9	$57.9	$59.41	$58.64	$57.71	$58.06
Farebox Ratio	44.6%	46.1%	44.9%	46.9%	49.6%	49.8%	50.6%	51.8%
Annual State Costs[a] (in Millions of Dollars)	$29.6	$27.5	$29.7	$30.2	$29.92	$29.45	$28.48	$27.96
State Costs – Administration (in Millions of Dollars)	$1.3	$1.3	$1.3	$1.3	$2.72	$2.72	$2.72	$2.72
State Costs – Marketing (in Millions of Dollars)	$1.2	$1.2	$1.2	$1.2	$1.20	$1.20	$1.20	$1.20
State Cost per Passenger	$17.46	$17.18	$18.78	$17.65	$17.13	$17.31	$20.07	$18.96
State Cost per Passenger Mile	$0.27	$0.27	$0.29	$0.28	$0.27	$0.26	$0.30	$0.28
State Cost per Train Mile	$24.88	$23.17	$25.06	$25.16	$24.92	$25.30	$24.66	$23.90
Annual Ridership	1,693,580	1,599,625	1,580,619	1,708,618	1,746,397	1,701,185	1,419,134	1,474,873
Annual Passenger Miles	109,881,568	102,282,980	101,250,743	109,073,594	111,191,130	112,158,131	96,160,598	98,942,984
Annual Train Miles	1,188,104	1,186,351	1,184,181	1,198,842	1,200,493	1,164,118	1,154,770	1,169,957
On-Time Performance	86.0%	92.3%	93.1%	94.9%	93.9%	95.0%	95.3%	93.0%

Performance Measure	Actual							
	FFY 08	FFY 09	FFY 10	FFY 11	FFY 12	FFY 13	FFY 14	FFY 15
Frequency (Daily Round Trips)								
San Jose-Oakland	7	7	7	7	7	7	7	7
Oakland-Sacramento[b]	16	16	16	16	15	15	15	15
Sacramento-Auburn	1	1	1	1	1	1	1	1

Source: Caltrans rail operational database.
Note: This table is intended to satisfy the performance evaluation requirements of AB 528. [a]State costs do not include equipment lease costs, and may include minor capital project costs.
[b] About 12 weekend round trips.

Rail Operating Expenditures FY2013 – 2017

Table A.11.1: Rail Operating Expenditures FY2013 – 2017

Fiscal Year	Provider	Ops	Grand Total
11-12	CCJPA	$5,439,261	$5,947,133
12-13	CCJPA	$29,110,318	$33,735,318
12-13	Amtrak		$68,987,954
13-14	CCJPA	$29,681,000	$33,809,381
13-14	Amtrak		$86,388,592
14-15	CCJPA	$32,595,784	$37,121,281
14-15	Amtrak		$122,876,248
15-16	CCJPA	$31,745,660	$35,640,660
15-16	LOSSAN	$7,590,815	$12,208,327
15-16	SJJPA	$7,915,795	$10,542,076
15-16	Amtrak		$25,028,035
16-17	CCJPA	$31,503,745	$35,858,745
16-17	LOSSAN	$33,006,040	$36,503,496
16-17	SJJPA	$43,439,104	$45,626,894
Total		**$252,027,522**	**$590,274,141**

Table A.11.2: Proposed Rail Capital and Operating Expenditures FY 2018-2023*

	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	5-Year Total	6-Year Total
Intercity Rail and Bus Operations	$120,776	$125,607	$130,631	$135,857	$141,291	$146,942	$680,328	$801,104
San Joaquin Service: 8th Round Trip Operations	$0	$0	$0	$7,725	$8,034	$8,355	$24,114	$24,114
Heavy Equipment Overhaul: Existing	$39,985	$55,289	$23,997	$7,685	$7,285	$7,285	$101,540	$140,526
Equipment Overhaul: New Railcars and Locomotives	$0	$0	$0	$0	$635	$1,144	$1,779	$1,779
Total Intercity Rail Capital and Operating Expenditures	**$159,761**	**$180,896**	**$154,628**	**$151,267**	**$157,245**	**$163,727**	**$807,762**	**$967,523**

***-All figures from 2018 STIP Fund Estimate**

Rail Capital Expenditures FY2013 - 2017

Table A.12: Rail Capital Expenditures FY2013 – 2017

Start	End	Contract Amount	Expenditures Prior to 7/1/12	Expenditure within parameters	Expenditure After 6/30/17	Appr Cat	Appr Unit
08/10/11	08/09/13	$800,000.00	$-	$799,999.70	$-	1112	12301
09/22/10	06/30/16	$46,550,000.00	$-	$40,549,168.85	$-	1011	11304
01/29/14	06/30/16	$6,500,000.00	$-	$6,080,563.00	$-	1314	14304
10/14/14	10/14/17	$1,000,000.00	$-	$849,144.26	$145,791.80	1314	14301
		$1,501,298.52	$1,199,248.61	$246,566.24	$-	0910	10301F
08/15/06	06/30/16	$36,817,892.63	$20,034,111.73	$16,575,013.68	$-	0708	08304
		$677,731.00	$655,401.00	$11,843.00	$-	0607	07302
		$4,117,289.51	$59,042.34	$-	$-	0607	07302
	06/30/15	$21,285,787.00	$-	$-	$-	0708	08304
		$8,322,102.00	$4,518,969.00	$-	$-	0708	08304
02/07/11	02/06/16	$13,295,511.00	$5,234,372.83	$7,935,932.77	$-	1011	11301F
01/01/10	06/30/17	$30,051,000.00	$-	$26,769,644.49	$-	1112 & 1314	12304 & 14304
01/24/11	06/30/16	$19,642,361.48	$-	$13,754,662.12	$-	1011 & 1112	11304 & 12304
01/20/11	06/30/16	$3,530,000.00	$-	$-	$-	0910 & 1011	10301 & 11301
01/20/11	01/30/15	$14,888,960.00	$4,972,106.36	$9,495,379.71	$-	1011	11304
08/15/11	11/04/13	$7,200,000.00	$6,870,283.83	$-	$-	1011	11304
11/21/11	12/31/13	$957,107.00	$-	$688,488.61	$-	1011	11301 R
09/01/11	08/31/15	$34,424,489.00	$3,095,752.42	$25,326,615.34	$-	1011	11301F
12/20/11	12/19/14	$8,384,392.00	$1,167,658.80	$7,164,325.99	$-	1011	11301F
08/15/11	08/15/14	$27,847,000.00	$591,347.83	$27,254,799.44	$-	1112	12304
09/01/12	02/28/17	$26,450,000.00	$-	$3,218,467.74	$-	1112	12301 & 12304
10/27/11	10/26/15	$6,936,000.00	$-	$4,092,746.52	$-	1011	11304
02/23/15	08/31/18	$4,200,000.00	$-	$1,031,848.33	$1,213,658.45	1112	12301

Start	End	Contract Amount	Expenditures Prior to 7/1/12	Expenditure within parameters	Expenditure After 6/30/17	Appr Cat	Appr Unit
11/04/13	09/30/15	$300,000.00	$-	$70,058.57	$-	1011	11301F & 11301 R
11/16/12	12/31/20	$113,812,246.15	$-	$16,218,245.07	$-	1112	12301F & 12304
08/27/12	06/30/15	$860,000.00	$-	$848,830.12	$-	1112	12301
03/29/12	03/28/15	$40,718,000.00	$-	$40,717,999.99	$-	1112	12304
11/04/13	09/30/15	$300,000.00	$-	$55,014.05	$-	1112 & 1011	12301F & 11301 R
03/01/12	08/31/18	$28,900,000.00	$-	$24,265,834.51	$2,697,074.84	1011 & 1314	11301 & 14301
10/24/12	06/30/18	$65,800,000.00	$-	$64,576,614.52	$-	1112	12304
04/29/13	04/28/16	$3,445,000.00	$-	$3,445,000.00	$-	1011 & 1112	12304
06/01/13	02/28/17	$3,350,000.00	$-	$1,982,554.39	$1,320,942.99	1112	12301
10/24/12	07/31/16	$25,900,000.00	$-	$25,900,000.00	$-	1112	12304
03/06/13	06/30/17	$9,423,000.00	$-	$9,423,000.00	$-	1112	12304
11/01/13	10/31/19	$40,750,000.00	$-	$28,026,403.13	$66,862.17	1213	13304
05/07/13	05/06/17	$176,341,000.00	$-	$169,919,268.32	$3,715,002.63	1112	12304
07/29/13	03/31/18	$8,700,000.00	$-	$7,131,813.67	$-	1112	12301
10/11/13	06/10/16	$26,664,000.00	$-	$26,664,000.00	$-	1112	12304
06/11/13	06/10/16	$20,712,000.00	$-	$19,460,912.32	$1,251,087.68	1213	13304
10/25/13	10/24/16	$12,994,000.00	$-	$12,994,000.00	$-	1112	12304
10/25/13	10/24/16	$21,621,000.00	$-	$21,621,000.00	$-	1112	12304
11/01/13	11/30/16	$17,209,743.00	$-	$15,882,657.44	$-	1314 & 1213	14102F & 13304
10/08/13	08/31/17	$4,400,000.00	$-	$4,400,000.00	$-	1314	14301
12/11/13	04/30/17	$4,000,000.00	$-	$3,597,820.00	$146,647.00	1314	14304
05/22/14	06/30/17	$1,305,000.00	$-	$1,297,606.95	$7,393.05	1314	14304
09/05/14	05/31/17	$12,270,000.00	$-	$1,270,000.00	$-	1314	14304
08/20/14	10/31/17	$7,418,000.00	$-	$6,421,992.36	$49,103.18	1415 & 1314	15301 & 14304
10/08/14	10/08/17	$556,000.00	$-	$28,439.94	$89,736.79	1314	14301

Start	End	Contract Amount	Expenditures Prior to 7/1/12	Expenditure within parameters	Expenditure After 6/30/17	Appr Cat	Appr Unit
08/20/14	12/31/17	$11,000,000.00	$-	$9,971,850.42	$76,787.33	1314	14304
12/10/14	12/31/17	$8,200,000.00	$-	$7,210,525.04	$518,616.07	1415	15304
03/26/15	03/25/18	$8,401,000.00	$-	$7,733,461.34	$-	1415	15304
01/22/15	01/21/18	$2,841,000.00	$-	$-	$2,841,000.00	1314	14304
01/20/16	01/19/19	$1,000,000.00	$-	$-	$67,640.17	1415	15301
05/18/16	05/17/19	$900,000.00	$-	$-	$-	1415	15304
04/01/17	03/31/20	$800,000.00	$-	$-	$6,561.37	1617	17304
06/30/16	06/29/19	$2,708,000.00	$-	$-	$666,703.37	1415	15304
06/30/16	06/29/19	$1,455,000.00	$-	$-	$247,093.96	1415	15304
06/30/16	06/29/19	$1,790,000.00	$-	$10,626.14	$343,587.82	1415	15304
06/30/16	06/29/19	$1,455,000.00	$-	$-	$606,597.63	1415	15304
07/01/16	06/30/19	$10,180,000.00	$-	$3,471,339.11	$408,982.71	1213	13304
10/01/16	09/30/19	$30,500,000.00	$-	$107,291.36	$122,134.56	1415	15304
06/30/16	06/29/19	$1,132,000.00	$-	$-	$250,741.19	1516	16304
04/01/17	03/31/20	$23,000,000.00	$-	$-	$1,684,445.05	1617	17301
09/30/17	09/29/20	$1,000,000.00	$-	$-	$-	1617	17304
07/01/10	06/30/13	$74,000.00	$-	$-	$-	0001	01889
10/01/17	09/30/20	$5,000,000.00	$-	$-	$-	1516	16304
		$7,766,000.00	$-	$-	$-		
08/01/11	06/30/18	$24,900,000.00	$-	$13,263,971.45	$-	1112	12301F
07/01/12	09/30/17	$3,360,000.00	$-	$336,000.00	$-	1011	11301F
09/23/11	09/30/13	$1,524,000.00	$-	$1,477,021.67	$-	1112	12301F
09/23/11	09/30/13	$760,000.00	$-	$593,588.84	$-	1112	12301F
10/01/11	09/30/13	$4,764,369.00	$-	$4,654,759.01	$-	1011	11301F
12/01/10	05/31/15	$9,920,000.00	$-	$9,920,000.00	$-	1112	12301F
07/01/11	06/30/17	$6,920,000.00	$-	$5,329,184.52	$830,048.74	1112	12301F
10/01/11	04/30/18	$3,920,000.00	$-	$3,328,745.66	$10,645.57	1112	12301F
07/01/11	07/31/14	$380,000.00	$-	$380,000.00	$-	1112	12301F
07/01/10	12/31/16	$3,102,000.00	$-	$3,102,000.00	$-	1112	12301F
06/01/15	06/30/19	$82,583.00	$-	$-	$82,583.00	1516	16301F
		$47,188,630.68	$-	$30,169,293.30	$16,462,655.69	1112	12301F & 12304

Start	End	Contract Amount	Expenditures Prior to 7/1/12	Expenditure within parameters	Expenditure After 6/30/17	Appr Cat	Appr Unit
		$105,647,920.06	$-	$9,548,144.48	$2,232,814.53	1112 & 1415	12301F ,12304 & 15304
08/10/11	08/09/13	$800,000.00	$-	$799,999.70	$-	1112	12301
09/22/10	06/30/16	$46,550,000.00	$-	$40,549,168.85	$-	1011	11304
01/29/14	06/30/16	$6,500,000.00	$-	$6,080,563.00	$-	1314	14304
10/14/14	10/14/17	$1,000,000.00	$-	$849,144.26	$145,791.80	1314	14301
		$1,501,298.52	$1,199,248.61	$246,566.24	$-	0910	10301F
08/15/06	06/30/16	$36,817,892.63	$20,034,111.73	$16,575,013.68	$-	0708	08304
		$677,731.00	$655,401.00	$11,843.00	$-	0607	07302
		$4,117,289.51	$59,042.34	$-	$-	0607	07302
	06/30/15	$21,285,787.00	$-	$-	$-	0708	08304
		$8,322,102.00	$4,518,969.00	$-	$-	0708	08304
02/07/11	02/06/16	$13,295,511.00	$5,234,372.83	$7,935,932.77	$-	1011	11301F
01/01/10	06/30/17	$30,051,000.00	$-	$26,769,644.49	$-	1112 & 1314	12304 & 14304
01/24/11	06/30/16	$19,642,361.48	$-	$13,754,662.12	$-	1011 & 1112	11304 & 12304
01/20/11	06/30/16	$3,530,000.00	$-	$-	$-	0910 & 1011	10301 & 11301
01/20/11	01/30/15	$14,888,960.00	$4,972,106.36	$9,495,379.71	$-	1011	11304
08/15/11	11/04/13	$7,200,000.00	$6,870,283.83	$-	$-	1011	11304
11/21/11	12/31/13	$957,107.00	$-	$688,488.61	$-	1011	11301 R
09/01/11	08/31/15	$34,424,489.00	$3,095,752.42	$25,326,615.34	$-	1011	11301F
12/20/11	12/19/14	$8,384,392.00	$1,167,658.80	$7,164,325.99	$-	1011	11301F
08/15/11	08/15/14	$27,847,000.00	$591,347.83	$27,254,799.44	$-	1112	12304
09/01/12	02/28/17	$26,450,000.00	$-	$3,218,467.74	$-	1112	12301 & 12304
10/27/11	10/26/15	$6,936,000.00	$-	$4,092,746.52	$-	1011	11304
02/23/15	08/31/18	$4,200,000.00	$-	$1,031,848.33	$1,213,658.45	1112	12301

Start	End	Contract Amount	Expenditures Prior to 7/1/12	Expenditure within parameters	Expenditure After 6/30/17	Appr Cat	Appr Unit
11/04/13	09/30/15	$300,000.00	$-	$70,058.57	$-	1011	11301F & 11301 R
11/16/12	12/31/20	$113,812,246.15	$-	$16,218,245.07	$-	1112	12301F & 12304
08/27/12	06/30/15	$860,000.00	$-	$848,830.12	$-	1112	12301
03/29/12	03/28/15	$40,718,000.00	$-	$40,717,999.99	$-	1112	12304
11/04/13	09/30/15	$300,000.00	$-	$55,014.05	$-	1112 & 1011	12301F & 11301 R
03/01/12	08/31/18	$28,900,000.00	$-	$24,265,834.51	$2,697,074.84	1011 & 1314	11301 & 14301
10/24/12	06/30/18	$65,800,000.00	$-	$64,576,614.52	$-	1112	12304
04/29/13	04/28/16	$3,445,000.00	$-	$3,445,000.00	$-	1011 & 1112	12304
06/01/13	02/28/17	$3,350,000.00	$-	$1,982,554.39	$1,320,942.99	1112	12301
10/24/12	07/31/16	$25,900,000.00	$-	$25,900,000.00	$-	1112	12304
03/06/13	06/30/17	$9,423,000.00	$-	$9,423,000.00	$-	1112	12304
11/01/13	10/31/19	$40,750,000.00	$-	$28,026,403.13	$66,862.17	1213	13304
05/07/13	05/06/17	$176,341,000.00	$-	$169,919,268.32	$3,715,002.63	1112	12304
07/29/13	03/31/18	$8,700,000.00	$-	$7,131,813.67	$-	1112	12301
10/11/13	06/10/16	$26,664,000.00	$-	$26,664,000.00	$-	1112	12304
06/11/13	06/10/16	$20,712,000.00	$-	$19,460,912.32	$1,251,087.68	1213	13304
10/25/13	10/24/16	$12,994,000.00	$-	$12,994,000.00	$-	1112	12304
10/25/13	10/24/16	$21,621,000.00	$-	$21,621,000.00	$-	1112	12304
11/01/13	11/30/16	$17,209,743.00	$-	$15,882,657.44	$-	1314 & 1213	14102F & 13304
10/08/13	08/31/17	$4,400,000.00	$-	$4,400,000.00	$-	1314	14301
12/11/13	04/30/17	$4,000,000.00	$-	$3,597,820.00	$146,647.00	1314	14304
05/22/14	06/30/17	$1,305,000.00	$-	$1,297,606.95	$7,393.05	1314	14304
09/05/14	05/31/17	$12,270,000.00	$-	$1,270,000.00	$-	1314	14304
08/20/14	10/31/17	$7,418,000.00	$-	$6,421,992.36	$49,103.18	1415 & 1314	15301 & 14304
10/08/14	10/08/17	$556,000.00	$-	$28,439.94	$89,736.79	1314	14301

Start	End	Contract Amount	Expenditures Prior to 7/1/12	Expenditure within parameters	Expenditure After 6/30/17	Appr Cat	Appr Unit
	12/31/17	$11,000,000.00	$-	$9,971,850.42	$76,787.33	1314	14304
12/10/14	12/31/17	$8,200,000.00	$-	$7,210,525.04	$518,616.07	1415	15304
03/26/15	03/25/18	$8,401,000.00	$-	$7,733,461.34	$-	1415	15304
01/22/15	01/21/18	$2,841,000.00	$-	$-	$2,841,000.00	1314	14304
01/20/16	01/19/19	$1,000,000.00	$-	$-	$67,640.17	1415	15301
05/18/16	05/17/19	$900,000.00	$-	$-	$-	1415	15304
04/01/17	03/31/20	$800,000.00	$-	$-	$6,561.37	1617	17304
06/30/16	06/29/19	$2,708,000.00	$-	$-	$666,703.37	1415	15304
06/30/16	06/29/19	$1,455,000.00	$-	$-	$247,093.96	1415	15304
06/30/16	06/29/19	$1,790,000.00	$-	$10,626.14	$343,587.82	1415	15304
06/30/16	06/29/19	$1,455,000.00	$-	$-	$606,597.63	1415	15304
07/01/16	06/30/19	$10,180,000.00	$-	$3,471,339.11	$408,982.71	1213	13304
10/01/16	09/30/19	$30,500,000.00	$-	$107,291.36	$122,134.56	1415	15304
06/30/16	06/29/19	$1,132,000.00	$-	$-	$250,741.19	1516	16304
04/01/17	03/31/20	$23,000,000.00	$-	$-	$1,684,445.05	1617	17301
09/30/17	09/29/20	$1,000,000.00	$-	$-	$-	1617	17304
07/01/10	06/30/13	$74,000.00	$-	$-	$-	0001	01889
10/01/17	09/30/20	$5,000,000.00	$-	$-	$-	1516	16304
		$7,766,000.00	$-	$-	$-		
08/01/11	06/30/18	$24,900,000.00	$-	$13,263,971.45	$-	1112	12301F
07/01/12	09/30/17	$3,360,000.00	$-	$336,000.00	$-	1011	11301F
09/23/11	09/30/13	$1,524,000.00	$-	$1,477,021.67	$-	1112	12301F
09/23/11	09/30/13	$760,000.00	$-	$593,588.84	$-	1112	12301F
10/01/11	09/30/13	$4,764,369.00	$-	$4,654,759.01	$-	1011	11301F
12/01/10	05/31/15	$9,920,000.00	$-	$9,920,000.00	$-	1112	12301F
07/01/11	06/30/17	$6,920,000.00	$-	$5,329,184.52	$830,048.74	1112	12301F
10/01/11	04/30/18	$3,920,000.00	$-	$3,328,745.66	$10,645.57	1112	12301F
07/01/11	07/31/14	$380,000.00	$-	$380,000.00	$-	1112	12301F
07/01/10	12/31/16	$3,102,000.00	$-	$3,102,000.00	$-	1112	12301F
06/01/15	06/30/19	$82,583.00	$-	$-	$82,583.00	1516	16301F
		$47,188,630.68	$-	$30,169,293.30	$16,462,655.69	1112	12301F & 12304

Start	End	Contract Amount	Expenditures Prior to 7/1/12	Expenditure within parameters	Expenditure After 6/30/17	Appr Cat	Appr Unit
		$105,647,920.06	$-	$9,548,144.48	$2,232,814.53	1112 & 1415	12301, 12304 & 15304
		$1,304,799,413.03	**$48,398,294.75**	**$808,672,077.48**	**$38,162,939.34**		

Amtrak Long Distance Routes

California at a Glance

- Approximately 70 Amtrak trains a day
- Nearly 12 million train riders at California stations
- Over $98 million in Amtrak procurement
- 2,510 residents employed by Amtrak
- Total resident employee wages, nearly $173 million
- Over 869,000 California residents are members of the Amtrak Guest Rewards frequent user program
- Amtrak-State partnerships: *Pacific Surfliners, San Joaquins, Capitol Corridor*

Amtrak Service & Ridership

Amtrak operates approximately 70 intercity trains and 100 commuter trains per day in California. This includes the following National Network trains through California:

- The ***California Zephyr*** (daily San Francisco Bay Area-Salt Lake City-Chicago)
- The ***Coast Starligh****t* (daily Los Angeles-Oakland-Seattle)
- The ***Southwest Chief*** (daily Los Angeles-Albuquerque-Chicago)
- The ***Sunset Limited*** (tri-weekly Los Angeles-New Orleans-Orlando)*

*****Sunset Limited ***service suspended east of New Orleans.***

Employment

At the end of FY17, Amtrak employed 2,510 California residents. Total wages of Amtrak employees living in California were $172,711,334 during FY17.

Table A.13: Amtrak station boardings and alightings in California from FY '15 to FY '17 identifies Amtrak station boardings and alightings in California from FY '15 to FY '17.

Table A.13: Amtrak station boardings and alightings in California from FY '15 to FY '17

City	Rail Boardings + Alightings		
	FY '15	FY '16	FY '17
Anaheim	270,819	282,700	287,415
Antioch-Pittsburg	43,217	39,995	38,103
Auburn	14,779	15,732	13,352
Bakersfield	513,884	491,824	482,276
Barstow	3,463	3,153	3,509
Berkeley	136,997	150,636	156,226
Burbank	67,924	68,918	73,814
Camarillo	51,831	52,310	54,582
Carlsbad Poinsettia (a)	9,363	10,556	10,074
Carlsbad Village	13,455	14,843	14,522
Carpinteria	29,461	30,762	32,701
Chatsworth	72,132	71,133	72,278
Chico	13,736	13,144	12,154
Colfax	4,631	6,277	7,035
Corcoran	32,331	30,104	28,440
Davis	372,554	379,073	375,626
Dunsmuir	6,166	5,958	5,330
Emeryville	587,926	581,573	581,138
Encinitas (a)	11,945	12,975	13,224
Fairfield-Vacaville (b)	NA	NA	NA
Fremont	35,475	40,617	41,751
Fresno	387,640	369,582	374,479
Fullerton	370,334	388,068	399,695
Glendale 55,032	51,009	52,395	55,032
Goleta 78,365	75,677	76,286	78,365
Great America (Santa Clara)	131,129	151,802	167,475
Grover Beach	19,437	18,987	18,879
Guadalupe	12,718	12,227	12,430

City	Rail Boardings + Alightings		
	FY '15	FY '16	FY '17
Hanford	213,923	201,098	196,702
Hayward	40,631	47,351	50,361
Irvine	421,736	450,732	440,986
Lodi	10,185	8,617	7,978
Lompoc-Surf	8,158	7,921	7,823
Los Angeles (c)	1,589,391	1,635,039	1,716,392
Madera	27,718	27,136	27,751
Martinez	363,717	364,372	347,095
Merced	128,327	121,137	126,148
Modesto	121,389	117,422	115,672
Moorpark	20,696	21,726	21,881
Needles	8,656	8,017	9,176
Oakland	319,336	344,112	371,257
Oakland Coliseum	57,491	70,520	77,057
Oceanside	385,128	416,021	394,122
Ontario	4,824	4,864	4,575
Oxnard	96,662	92,805	94,000
Palm Springs	3,130	3,042	3,142
Paso Robles	12,149	12,037	11,377
Pomona	1,812	1,716	1,601
Redding	12,345	11,208	10,475
Richmond	251,372	269,838	292,453
Riverside	12,837	12,287	12,029
Rocklin	15,074	16,403	15,926
Roseville	34,528	39,409	38,638
Sacramento (d)	1,027,013	1,051,001	1,073,584
Salinas	21,836	21,498	20,564
San Bernardino	12,287	11,579	12,035
San Clemente Pier	13,559	15,396	14,926
San Diego (e)	773,497	777,352	777,961
San Diego-Old Town	238,288	267,481	300,245
San Jose	215,158	223,055	223,028

City	Rail Boardings + Alightings		
	FY '15	FY '16	FY '17
San Juan Capistrano	226,596	229,408	229,153
San Luis Obispo	110,966	107,778	105,156
Santa Ana	182,291	191,716	194,581
Santa Barbara	333,994	338,069	341,899
Santa Clara (University)	30,267	42,644	45,135
Simi Valley	49,756	51,049	52,064
Solana Beach	408,248	396,157	387,956
Sorrento Valley	16,523	20,720	27,335
Stockton (Downtown)	40,428	37,916	32,266
Stockton (San Joaquin St.)	293,861	283,213	297,699
Suisun-Fairfield	164,288	167,994	164,709
Truckee	10,846	14,675	14,879
Turlock-Denair	29,791	29,197	29,924
Van Nuys	80,957	80,405	82,417
Ventura	61,812	65,328	67,522
Victorville	7,266	6,664	6,292
Wasco	39,678	41,424	41,828
Total California Station Rail Usage	**11,890,454**	**12,148,179**	**12,347,680**

Ridership notes:
a) Service ended on 10/9/17, during Fiscal 2018
b) Service began on 11/13/17, during Fiscal 2018
c) Los Angeles is the 5th busiest station in the national Amtrak System
d) Sacramento is the 7th busiest station in the national Amtrak System
e) San Diego is the 10th busiest station in the national Amtrak System

Amtrak Long Distance Route Map

Map of the Amtrak Thruway Bus routes are shown on Exhibit A.1 and Exhibit A.2: **Amtrak Thruway Bus Service (Central California)**
for California.

Exhibit A.4: Amtrak Long Distance Route Map

--Amtrak Government Affairs, fall 2017

Appendix A.2 California's Freight Railroad System

Table A.14: Class I Railroad Operating Characteristics[5]

Name	Employees	Payroll (Millions of Dollars)	Route Miles Owned	Route Miles w/ Trackage Rights	Total Miles Operated	Originating Carloads	Terminating Carloads
UPRR	4,783	$462.8	2,773[6]	515[7]	3,292	1,537,094,034	1,594,670
BNSF	3,655	$283.8	1,149	965	2,114	1,948,082	1,982,279

Rail Line Abandonments

This section describes rail infrastructure whose owners have filed for abandonment with the STB since 2005. With approval to abandon a line, the right-of-way can be freed for other uses, including rail banking (e.g., preservation for potential future use as a rail line), reversion to line-side property owners, or redevelopment as a trail or transit line. Rail lines are usually abandoned because they are unprofitable to operate due to declining traffic potential—either on the line alone, or in the larger region. Due to the declining traffic, these lines commonly suffer from deferred maintenance, which raises operating costs and further reduces their commercial viability. Because developable land is scarce and sold at a premium, abandoned rail lines and adjacent right-of-way offer one way to accommodate the need for passenger rail service, non-motorized transport, and recreational activity.

Table A.15 identifies rail line abandonment filings since 2005.

[5] Sources: UPRR *California Fact Sheet 2015*;; BNSF *California Fact* Sheet 2014; 2013 *California State Rail Plan*

[6] Caltrans, *2013 California State Rail Plan,* 2013.

[7] Ibid.

Table A.15: Rail Line Abandonment Filings with the FRA, 2005 to 2015[8]

Owner/Line	Name	Year	Counties	City	Length
UPRR; Santa Clara Valley Transportation Authority		2013	Alameda		1.97
UPRR		2013	Riverside; San Bernardino		1.27
Alameda Belt Line Railroad		2012	Alameda		2.61
UPRR; Santa Clara Valley Transportation Authority		2012	Plumas; Lassen		8.95
BNSF		2012	Los Angeles		5.3
UPRR		2011	Riverside; San Bernardino		3.73
BNSF Railway		2011	Los Angeles		4.85
Almanor Railroad Co.		2010	Plumas, Lassen	Clear Creek	12.3
BNSF	Alameda Beltline RR	2010	Alameda		2.0
UPRR	Brea Chemical Industrial Lead	2010	Orange	Brea	1.2
UPRR	South San Francisco Industrial Lead	2010	San Mateo		0.6
SDIY		2009	San Diego	Escondido	1.4
Arizona and California Railroad Co.		2009	San Bernardino and Riverside		49.4
Tulare Valley RR Co.		2009	Tulare	Ducor	5.9
UPRR	McHenry Industrial Lead	2009	San Joaquin and Stanislaus		5.2
UPRR (Nevada-CA)	Lassen Valley Railway LLC	2009			22.3
UPRR	Lakewood Industrial Lead	2008	Los Angeles	Lakewood	0.3
San Joaquin Valley RR Co.	South Exeter Branch	2008	Tulare		30.6
San Joaquin Valley RR Co.	South Exeter Branch	2008	Tulare		9.2
UPRR	Santa Monica Industrial Lead	2008	Los Angeles	Los Angeles	0.4
Metro	Santa Monica Industrial Lead	2008	Los Angeles		0.3
UPRR	Loyalton Industrial Lead	2007	Plumas and Sierra		11.1
UPRR	Loyalton Industrial Lead	2007	Sierra	Loyalton	0.7
BNSF		2007	Riverside	Riverside	0.5

[8] Source: FRA Abandonment filings (this source was last modified Nov. 2015)

Owner/Line	Name	Year	Counties	City	Length
UPRR	Riverside Industrial Lead	2007	Riverside		0.3
UPRR (Nevada-CA)	Flanigan Industrial Lead	2006			21.8
UPRR (Nevada-CA)	Susanville Industrial Lead	2006	Wendal, Lassen		0.6
UPRR	Pearson Industrial Lead	2006	Yuba		4.8
Sunset Railway Co/ San Joaquin Valley RR	Sunset Subdivision	2005	Kern	Levee	0.2
McCloud RR Co.		2005	Siskiyou, Shasta		80.0
Los Angeles Junction Railway		2005	Los Angeles	Maywood	0.5
Santa Clara Valley Transportation Authority	Industrial Line	2005	Santa Clara		0.2
Santa Clara Valley Transportation Authority	Milpitas Line	2005	Alameda	Fremont	2.8
UPRR	Tustin Industrial Lead	2005	Orange	Orange	1.5
UPRR	Holtville Industrial Lead	2005	Imperial County		9.38

An alternative to abandonment is to cease service over a line without pursuing formal abandonment. This approach allows a carrier to reinstate service when conditions change, with little or no regulatory requirements. For example, a railroad may retain an out-of-service line that may have a viable potential traffic base, but requires costly improvements for which funding needs to be secured; or offers an alternative route that may be needed in the future to accommodate traffic growth. An example of the former is the former Northwestern Pacific Railroad line between Windsor and Eureka (now owned by the North Coast Rail Authority); of the latter, UPRR's Mococo line between Tracy and Port Chicago (UPRR's Tracy Subdivision).

Major Rail Projects Funded under Section 130

There are 18 major rail projects funded under Section 130 along the State-supported intercity passenger rail corridors (*Capitol Corridor*, *San Joaquin*, and *Pacific Surfliner*). These projects are listed below by existing road crossing (city/county), in order from most improvements needed to least:

- **Rosecrans/Marquardt** (Santa Fe Springs / Los Angeles County)
- **Cutting Boulevard** (Richmond / Contra Costa County)
- **Washington Street** (San Diego / San Diego County)
- **La Palma Avenue** (Anaheim / Orange County)

- **Grand Ave/Santa Ana** (Santa Ana / Orange County)
- **Vineland Avenue** (Near Burbank / Los Angeles County)
- **Grand Avenue/Carlsbad** (Carlsbad / San Diego County)
- **Los Nietos Road** (Santa Fe Springs / Los Angeles County)
- **Ferry Street** (Martinez / Contra Costa County)
- **Mission Avenue** (Oceanside / San Diego County)
- **Church Avenue** (Fresno / Fresno County)
- **Hesperian Boulevard** (San Leandro / Alameda County)
- **Grape Street** (San Diego / San Diego County)
- **Hawthorn Street** (San Diego / San Diego County)
- **7th Street** (Hanford / Kings County)
- **Kansas Avenue** (Near Guernsey / Kings County)
- **11th Avenue** (Hanford / Kings County)
- **Bellevue Avenue** (Atwater / Merced County)

Appendix A.3 Statewide Trends and Forecasts

Highway Congestion Analysis

Table A.16, below, presents 5 years of mainline Annual Average Daily Traffic (AADT) volumes obtained from the Caltrans Freeway Performance Measurement System (PeMS) database for specific locations along I-5, I-10, and I-80. These freeways parallel existing BNSF and UPRR lines. The changes in AADT over the years demonstrate the traffic growth patterns. Many areas have been seen traffic increase over the last 5 years; the increases are not limited to metropolitan areas like Los Angeles and San Francisco Counties. Traffic volumes are also seen to be increasing in inland counties like Merced and Stanislaus Counties (along I-5), and Solano and Placer Counties (along I-80).

Table A.16: AADT per Location on I-5, I-10 and I-80 from 2011 to 2015

I-10 EB Mainline AADT									
County	**City**	**Abs PM**	**Location**	**# of Lane**	**2011**	**2012**	**2013**	**2014**	**2015**
LA	Santa Monica	0.93	20th St	3	65114	68654	66078	64693	66063
San Bernardino	Ontario	52.06	4th St	4	96569	103836	101423	102218	101784
Riverside	Banning	99.27	San Gorgonio OC	4		58389	60779	61996	
	Coachella	152.7	Brown Arroyo	2		14120	13466		
I-10 WB Mainline AADT									
County	**City**	**Abs PM**	**Location**	**# of Lane**	**2011**	**2012**	**2013**	**2014**	**2015**
LA	Santa Monica	0.48	14th St	3	66592	72211	71467	70945	72107
San Bernardino	Ontario	52.06	4th St	4	99574	100117	100611	101709	101541
Riverside	Coachella	152.7	Brown Arroyo	2		14545	14077	14175	

I-80 EB Mainline AADT									
County	City	Abs PM	Location	# of Lane	2011	2012	2013	2014	2015
San Francisco	San Francisco	3.3	Bay Bridge S - Curve	5	96721	89851	93316	119657	129000
Alameda	Oakland	6.74	1400' E of Bay Bridge	6		94645	100845	120253	133699
Solano	Un-incorporated	51.44	E of Pleasant Valley OC	4	73032	66166	72154	81310	96992
Sacramento	Un-incorporated	98.1	WB Green Back Lane	4	76610	78094	78688	80909	83143
Placer	Un-incorporated	145.92	Alta Rd	2	12738	12884	13198	13682	14778

I-80 WB Mainline AADT									
County	City	Abs PM	Location	# of Lane	2011	2012	2013	2014	2015
San Francisco	San Francisco	3.3	Bay Bridge	5	106917	116261	117334	127608	
Alameda	Oakland	6.74	1400' E of Bay Bridge	5		127469	146370	145419	146282
Solano	Un-incorporated	51.44	E of Pleasant Valley OC	4	82472	84761	67710	83239	96167
Sacramento	Un-incorporated	98	WB Elkhom Blvd	4	69582	70238	70429	72109	72956
Placer	Un-incorporated	145.92	Alta Rd	2	12890	13123	13185	13473	14719

I-5 NB Mainline AADT									
County	City	Abs PM	Location	# of Lane	2011	2012	2013	2014	2015
San Diego	San Diego	13.02	National Ave.	4	66695	72609	70703	72939	75413
	Oceanside	52.30	Oceanside Blvd	4	87945	93027	89034	90142	91600
Orange	Santa Ana	103.50	1st St	5	137509	139825	138231	136079	136264
LA	LA	150.35	Sunland Blvd	4	81430	83703			79546
	Un-incorporated	194.62	Smokey Bear Rd	4			41611	37729	40216
Kern	Un-incorporated	258.95	N of SR 58 (Rest Area)	2			19791	18975	19761
Merced	Un-incorporated	390.10	S of Off Ramp to Vista Point Rd	2	18134	19455	21029		
Stanislaus	Un-incorporated	433.70	Sperry Ave	2	20504	22119	21901	22945	23666
San Joaquin	Stockton	478.96	Mosher Slough	3	40193	24973	41041	34450	
Sacramento	Sacramento	524.19	Del Paso Rd	3			48495	51739	54757

I-5 NB Mainline AADT									
County	City	Abs PM	Location	# of Lane	2011	2012	2013	2014	2015
San Diego	San Diego	13.02	S of 29th	4	65594	70198	68096	69591	72275
	Oceanside	52.27	Oceanside Blvd	4	86069	90579	86429	87497	88963
Orange	Santa Ana	103.09	4th St	5	141327	143675	141838	143360	143236
LA	LA	152.41	Penrose St	4	59263	57738			89045
Kern	Un-incorporated	258.88	N of SR 58 (Rest Area)	2			20753	20201	21001
Merced	Un-incorporated	391.1	S of On Ramp from Rte 165/Mercy	2	16445	17578	18048	16502	
Stanislaus	Un-incorporated	433.64	Sperry Ave	2	19329	20839	20569	21457	22628
San Joaquin	Stockton	478.57	N of Hammer Lane	3		42647	39806	39772	
Sacramento	Sacramento	524.29	EB Del Paso Rd	4	60808	61646	58015	58696	60727

Source: PeMs Website (pems.dot.ca.gov)
Note: Abs PM = Absolute Post Mile

This trend of increasing traffic volume is also seen in the amount of time segments of these freeways experience Level of Service (LOS) D or worse throughout the course of a typical day. Table A.17 shows the percentage during the AM (6 to 9 am) and PM peak (4 to 7 pm) hours that a freeway (within a specific county) is experiencing LOS D or worse. It can be seen that portions of the freeways at LOS D or worse are increasing over the 5-year period. This trend is observed in both metropolitan counties like Alameda (along I-80) and Los Angeles (along I-10), and in counties in the Central Valley like Merced and San Joaquin (along I-5).

Table A.17: Percentage of Flow Worse Than or Equal to LOS D on I-5, I-10, and I-80 from 2011 to 2015

I-80 EB Alameda County Segment Mainline Weekday – % Worse Than or Equal to LOS D					
Time	**2011**	**2012**	**2013**	**2014**	**2015**
6:00	0	0	0	0.31	0
7:00	0	0	0.55	1.89	4.32
8:00	0	1.09	5.11	3.4	8.36
16:00	43.79	58.61	76.21	66.54	78.52
17:00	44.18	65.3	79.53	69.02	78.09
18:00	38.21	61.91	77.99	66.55	79.66
I-80 WB Alameda County Segment Mainline Weekday – % Worse Than or Equal To LOS D					
Time	**2011**	**2012**	**2013**	**2014**	**2015**
6:00	23.29	25.19	24.57	23.33	38.93
7:00	42.62	40.88	42.62	42.66	52.53
8:00	40.7	35.31	32.71	34.21	36.14
16:00	6.12	13.86	22.15	19.58	27.08
17:00	10.03	15.44	27.85	22.49	30.93
18:00	7.47	11.19	10.65	9.82	12.1

I-80 WB Sacramento County Segment Mainline Weekday – % Worse Than or Equal To LOS D					
Time	2011	2012	2013	2014	2015
6:00	17.88	19.09	29.3	25.41	39.12
7:00	68.21	54.88	60.59	58.47	71.64
8:00	64.81	41.64	56.38	43.76	45.8
16:00	9.2	1.06	24.15	28.35	42.33
17:00	7.23	2.14	24.11	27.01	40.52
18:00	1.03	0.66	7.19	6.62	7.38
Note: no data available for EB					

I-10 EB LA County Segment Mainline Weekday – % Worse Than or Equal To LOS D					
Time	2011	2012	2013	2014	2015
6:00	0.58	23.29	5.87	1.97	1.49
7:00	39.49	55.2	38.78	39.62	42.36
8:00	49.37	64.19	50.73	50.41	54.02
16:00	83.45	82.32	84.1	83.93	86.27
17:00	84.46	85.94	87.15	86.34	89.18
18:00	83.29	83.22	81.32	83.98	87.58
Note: No data available for other counties					

I-10 WB LA County Segment Mainline Weekday – % Worse Than or Equal To LOS D					
Time	2011	2012	2013	2014	2015
6:00	71.11	66.24	76.06	82.05	82.85
7:00	74.25	84.53	86.41	88.92	87.18
8:00	67.74	79.73	80.34	83.68	85.83
16:00	31.55	48.44	39.06	34.1	40.86
17:00	44.42	57.44	55.12	51.1	57.71
18:00	40.38	42.51	42.64	41.3	45.38
Note: No data available for other counties					

I-5 NB Merced County Segment Mainline Weekday – % Worse Than or Equal To LOS D					
Time	2011	2012	2013	2014	2015
6:00	19.77	18.45	21.26	19.99	22.75
7:00	45.24	44.89	46.04	46.66	45.93
8:00	43.2	42.22	44.66	44.51	41.71
16:00	41.08	43.37	41.99	39.78	45.26
17:00	43.49	46.08	44.03	42.12	47.18
18:00	28.93	33.03	30.27	29.37	34.62
I-5 SB Merced County Segment Mainline Weekday – % Worse Than or Equal To LOS D					
Time	2011	2012	2013	2014	2015
6:00	23.08	27.4	34.29	31.19	33.36
7:00	45.09	43.39	49.22	43.06	46.53
8:00	40.97	39.62	43.62	37.75	41.92
16:00	48.15	43.14	48.35	43.11	45.96
17:00	50.61	46.88	51.35	44.68	47.88
18:00	32.88	28.2	34.32	28.05	29.71
I-5 NB San Joaquin County Segment Mainline Weekday – % Worse Than or Equal To LOS D					
Time	2011	2012	2013	2014	2015
6:00	0	0	0	0	0
7:00	0	0	0	0.41	3.65
8:00	0	0.52	0	0	0
16:00	6.21	5.43	10.37	7.61	13.21
17:00	6.91	9.78	11.04	3.79	11.08
18:00	0	1.19	0	0	0.31
Note: No data available for SB Source: PeMs Website (pems.dot.ca.gov)					

Freight Demand and Growth

Methodology

In estimating train volumes, the 2018 Rail Plan builds on the analysis conducted for the 2013 Rail Plan. For this Plan, the basic methodology for deriving base year (2013) and future year (2040) train volumes entailed adjusting train volumes from the 2013 Rail Plan to reflect expected changes in commodity flows using more recent data. The 2013 Plan conducted a network assignment of 2007 and 2040 rail tonnage flows to estimate daily average freight train volumes. The 2013 Rail Plan also validated the 2007 train volume estimates against freight train counts using available Class I (BNSF and UPRR) train count data for selected rail segments. Train volumes in Southern California were also compared to train volumes as estimated using the San Pedro Bay Ports' QuickTrip – Train Builder model. In using the 2013 Rail Plan train volume analysis as a foundation, the 2018 analysis yielded consistent results in an efficient manner.

For the 2018 Rail Plan, train volume estimation proceeded as follows:

- First, rail commodity flows were aggregated by service type (i.e., intermodal or carload) into a geographical set of rail segments. Using the origins and destinations of the current plan's rail commodity flows, traffic was assigned to rail segments using the 2013 Rail Plan's network assignment.
- Next, the ratios of the 2018 plan's base year tonnages (2013) to the previous plan's base year tonnages (2007) were calculated. Those ratios were then applied to the 2007 train volumes to estimate the 2013 train volumes.
- The estimation of future year train volumes for the current plan proceeded similarly. The ratios of the current plans forecast year tonnages (2040) to the previous plan's base year tonnages (2007) were calculated. Those ratios were then applied to the 2007 train volumes to estimate the 2018 Rail Plan's forecast year train volumes.
- The resulting train count data were incorporated into the capacity analysis that was conducted as part of the Service Development Plan, the results of which are provided in Section A.2.2.7.

Freight Flow

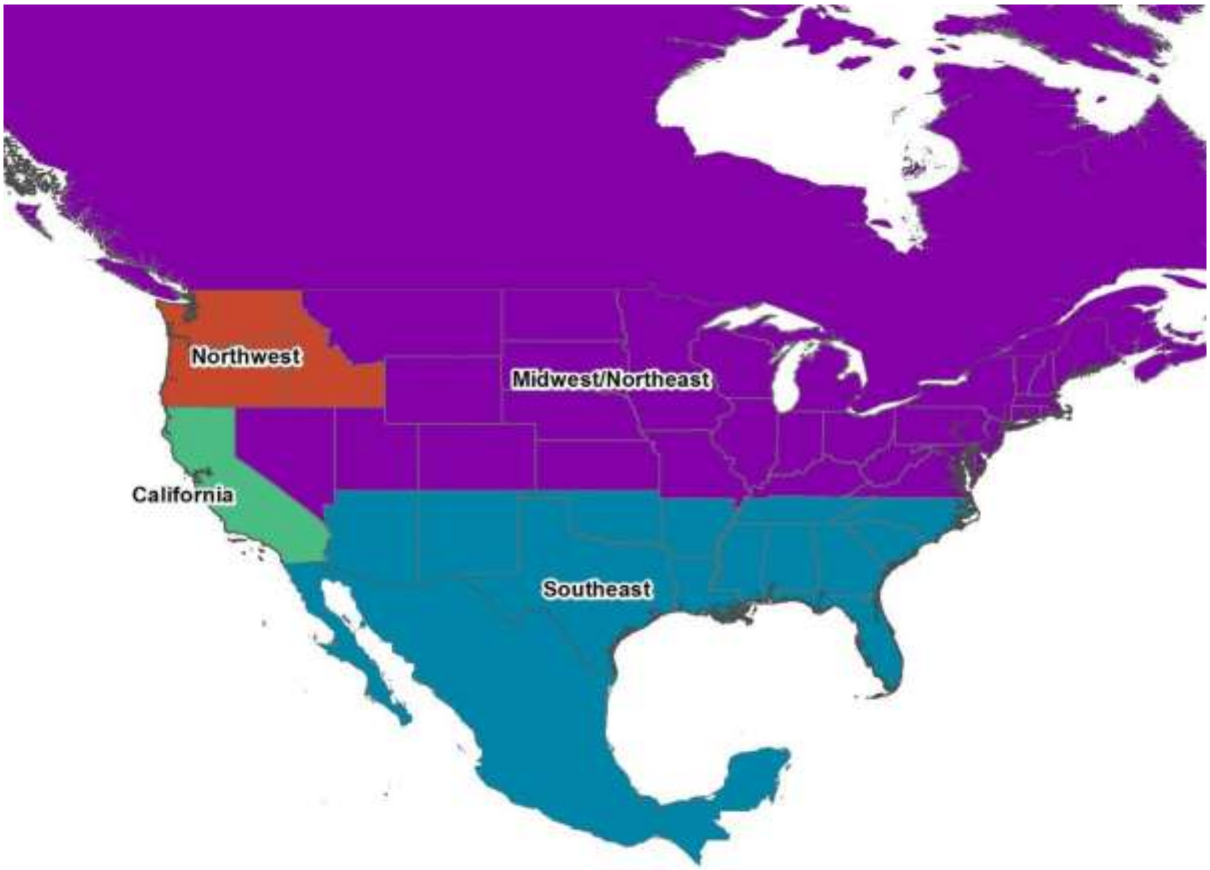


Exhibit A.5: Freight Flow Direction Categorization

Appendix A.4 Freight Flow Methodology

Appendix A.4
Freight Flow Methodology

List of Tables

List of Exhibits

List of Acronyms

BNSF	BNSF Railway
Caltrans	California Department of Transportation
CAGR	Compound Annual Growth Rate
CSRP	California State Rail Plan
CWS	Carload Waybill Sample
FAF	Freight Analysis Framework
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
GDP	Gross Domestic Product
NAICS	North American Industry Classification System
ODCM	Origin-Destination-Commodity-Mode
RTP	Regional Transportation Plan
SOUTHERN CALIFORNIA	Southern California Association of Governments
SCTG	Standard Classification of Transported Goods
SPLC	Standard Point Location Code
STB	Surface Transportation Board
STCC	Standard Transportation Commodity Code
UP	Union Pacific Railroad

Executive Summary

Examining the impact of future train volume changes on the rail system is a key element of the 2018 California State Rail Plan (CSRP). Changes from present train traffic volumes will affect the performance of the system, its capital needs, and potential shifts in mode share between rail and other competing modes. Since train volume changes will not be uniform across the entire network, some sections may be subject to substantial volume gains, others could face stable demand, while yet others could face declines. This technical memorandum describes how freight rail services are used by industries in California, how usage is expected to change over time, and how commodity flows and train volumes may change in the future.

Introduction

Examining the impact of future train volumes on the rail system is a key element of the 2018 California State Rail Plan (CSRP). Changes from present train traffic volumes will affect the performance of the system, its capital needs, and potential shifts in mode share between rail and competing modes. Since train volume changes will not be uniform across the entire network, some sections may be subject to substantial volume gains, others could face stable demand, while yet others could face declines. This document describes how California's freight rail system is used at present, and how commodity flows and train volumes may change in the future.

Throughout the analysis a base year of 2013 and forecast year of 2040 has been used. The 2013 base year was driven by the availability of historical data as this task was undertaken, and 2040 is consistent with the present plan year for Caltrans' long range planning efforts. The analysis relied on four principal data sources as follows:

1. **The Federal Highway Administration's Freight Analysis Framework (FAF3) database** containing aggregated annual volume summaries by origin-destination geography, mode, and commodity and provided this information on a historical and forecast basis, using a combination of actual data and modeled behavior. The version of FAF3 used in this analysis has a base year of 2007, with annual estimates for 2008 through 2013, and a forecast from Q2 2012, which was used to project traffic flows from 2014 through 2040.

2. **The US Surface Transportation Board's Confidential Carload Waybill Sample (CWS)** provided detailed information on a statistical sampling of rail shipments from 2007 and 2013.

3. **Base-year route-level traffic estimates** produced for the 2013 California State Rail Plan.

4. **Moody's Economy.com** Q3 2015 forecast of industry sector output that was used to adjust the FAF freight forecast.

CS' approach to utilizing this data is further discussed in the respective sections of this memorandum.

The memorandum is divided into three sections: The first, **Rail Traffic Trends**, discusses base- and forecast year conditions, with a focus on commodities, geography, trading partners and types of service. The second section, **Changes in Rail Volume Flows between 2013 and 2040** describes some of the key changes in traffic that are projected to occur between 2013 and 2040. The third and final section, **Train Volumes**, links rail traffic to physical network use in terms of train volumes for both the base and forecast years.

Rail Traffic Trends

A region's goods movement system reflects the industries and businesses that make up its economy. Heavy, low-value materials tend to be carried by transportation modes such as rail that can move large volumes at a low cost, while high-value materials favour transportation modes that offer fast and reliable delivery. Industries and businesses can be divided into two groups:

- **Freight-Intensive Industries**. Businesses that rely on physical goods as a key part of their business model. They may receive shipments of raw supplies as inputs to their manufacturing processes, require delivery of their own refined or finished products to market, or are involved in the process of fulfilling market demand for goods produced by others. Agriculture, manufacturing, wholesale and retail trade, construction, transportation and warehousing, electric utilities, and mining are economic sectors that are freight intensive. In California, all of these sectors rely to varying degrees on freight rail, and are thus the focus of goods movement analysis.
- **Service Industries**. Businesses that do not directly depend on the movement of raw or manufactured materials, but that do rely on small shipments of goods and supplies. This category includes industries such as government, education, health care, and other professional categories. To the extent that this traffic is handled by rail, most of it will appear as intermodal traffic.

Total Rail Flows and Flows by Direction of Movement

As shown in Exhibit 1, roughly 6.8 million units carrying 161 million tons of goods moved by rail in California in 2013. The majority moved inbound to destinations throughout California, 50 percent of all units and 58 percent of all tonnage.[1] About 11 million tons moved between origins and destinations within California (also known as "CA Local"), and 5 million tons traveled through the State between origins and destinations located beyond the State's borders (also known as "CA Through"). In 2013, both CA Local and CA Through tonnage had shown a decline from 2007 at 11.6 million tons and 6 million tons respectively.

[1] For purposes of clarity, this memorandum utilizes the term "unit" instead of "carload" when discussing reported rail traffic volumes. For carload service, a unit represents a railcar, while for intermodal service a unit represents a container or highway trailer. The latter has one-sixth to one-half the tonnage and volume capacity of a railcar.

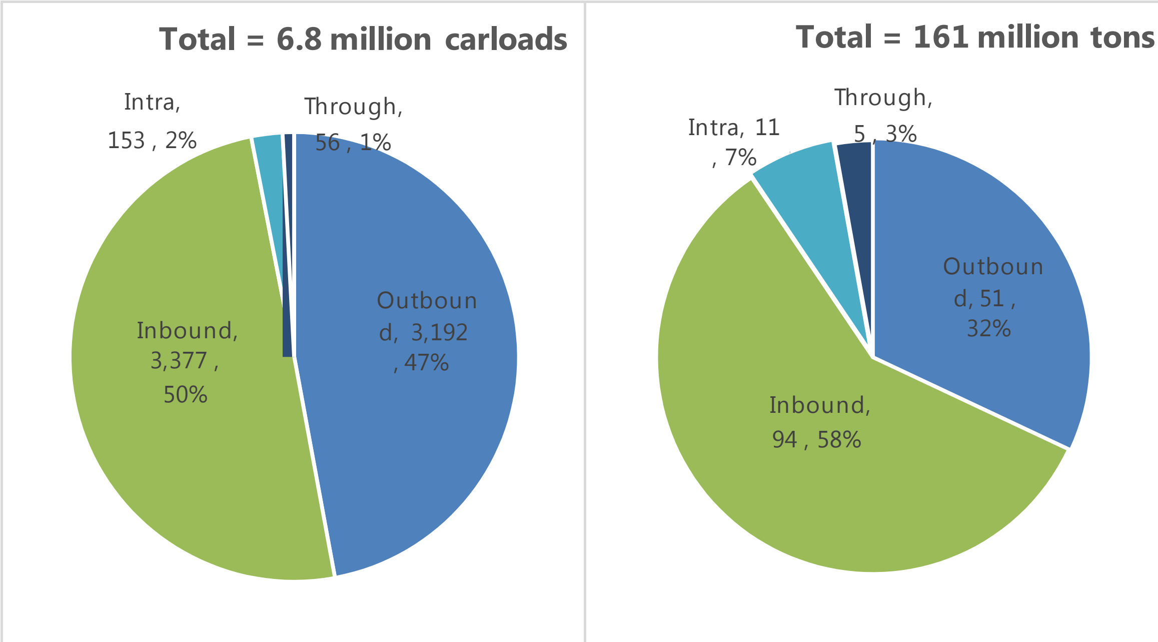


Exhibit 1: California Rail based Total Units (in thousands) and Tons (in millions), 2013

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

Though there are roughly the same number of units traveling inbound as there are traveling outbound in California, there is a clear imbalance in tonnage flows. Nearly twice as many tons move into California than move out of the state, indicating that the state is a net importer of commodities.

Flows by Rail Service Type

Another way to examine rail commodity movements is by service type. There are two primary service types, intermodal and carload, with the latter being further split into multiple categories in this analysis. Intermodal traffic involves the handling of an intact highway trailers and containers by rail. On the other hand, carload traffic includes assembled motor vehicles, bulk goods moved in dedicated trains handling commodities such as grain, coal, crude oil, etc., and general merchandise (such as lumber, bagged cement, etc.) that are shipped in carload quantities.

Table 1 details four primary service types, with intermodal movements comprising the bulk of rail activity in California in 2013, 85 percent of total units and 52 percent of total tonnage.

Table 1: California Rail based Units and Tons by Rail Service Type, 2013

Service Type	2013 Units (thousands)	% of Total Units	2013 Tons (millions)	% of Total Tons
Intermodal	5,783.9	85%	84.0	52%
Coal, coke, iron ore and bulk grain	145.8	2%	14.4	9%
Assembled motor vehicles	166.0	2%	3.6	2%
All other traffic	681.8	10%	58.6	37%
Total	**6,777.5**	**100%**	**160.6**	**100%**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

The trend in intermodal shipments is in line with the forecasts from the 2013 California State Rail Plan. In 2007, 48 percent of all tonnage was intermodal, and by 2040 it was expected that 65 percent of all tonnage would be intermodal. Intermodal service is particularly high in California due to the Ports of Los Angeles and Long Beach, which are the two busiest ports in the United States in terms of container volumes. Together, the ports comprised 33 percent of all container traffic in the United States in 2013,[2] a direct reflection of their importance as the primary gateway for Asian trade in the United States. The Port of Los Angeles functions as an import destination for Chinese, Japanese, South Korean, and other Asian goods to be shipped throughout the United States and Canada.[3] Similarly, the Port of Long Beach receives nearly half of its imports from China, followed by South Korea, Hong Kong, and Japan.[4]

Although intermodal service continues to grow in importance in California and throughout North America, carload service is still very important, particularly for the movement of motor vehicles, petroleum and chemical products, and select products manufactured by heavy industries as well as agricultural products and related inputs. Some carload shippers have become concerned with the emphasis on intermodal and unit train movements by Class I railroads, fearing that their access to service may be limited in the future. Small-volume rail shippers may be the most at risk to this change.

[2] "Port Industry Statistics". American Association of Port Authorities. Accessed January 7, 2016. Available from: http://www.aapa-ports.org/Industry/content.cfm?ItemNumber=900#Statistics
[3] "2013 Los Angeles Trade Numbers". World City, Inc. Accessed January 7, 2016. Available from: https://www.portoflosangeles.org/pdf/Los-Angeles-Trade-Numbers-2013.pdf
[4] "Port of Long Beach Cargo Statistics". Accessed January 7, 2016. Available from: http://www.polb.com/civica/filebank/blobdload.asp?BlobID=3945

Top Commodities

Total and By Direction of Movement

The numerous types of commodities carried on California's rail system reflect its diverse economy, as shown in Table 2 and Exhibit 2. The most common type of commodity transported by rail in California in 2013 is mixed freight (i.e. intermodal), representing 36 percent of all tonnage, a total of 57 million tons. Cereal grains are the second most transported commodity (nearly 14 million tons) and basic chemicals are the third most transported (over 12 million tons). Together, these three commodities comprise over half of the total tonnage transported in California.

Table 2: California Rail based Tons by SCTG-2 Digit Commodity Type, 2013

SCTG Code	SCTG Commodity	Tons (in thousands) by Commodity and Percentage Distribution by Direction					
		All Directions	% of Total	O/B	I/B	IN	THRU
43	Mixed freight	57,001	36%	55%	45%	< 1%	0%
2	Cereal grains	13,762	9%	2%	97%	< 1%	< 1%
20	Basic chemicals	12,491	8%	18%	71%	9%	3%
7	Other foodstuffs	7,649	5%	45%	52%	2%	1%
4	Animal feed	6,018	4%	2%	94%	3%	1%
26	Wood prods.	5,384	3%	11%	57%	< 1%	32%
32	Base metals	5,280	3%	15%	46%	36%	4%
19	Coal and petroleum prods.	5,157	3%	23%	40%	34%	3%
15	Coal	4,596	3%	0%	98%	0%	2%
27	Newsprint/paper	4,400	3%	2%	88%	3%	8%
36	Motorized vehicles	4,200	3%	30%	67%	0%	3%
31	Nonmetal min. prods.	3,846	2%	28%	30%	38%	4%
24	Plastics/rubber	3,631	2%	18%	74%	2%	7%
12	Gravel	3,144	2%	< 1%	1%	99%	0%
8	Alcoholic beverages	2,626	2%	81%	18%	0%	2%
41	Waste/scrap	2,303	1%	19%	74%	3%	4%
3	Other ag prods.	2,080	1%	52%	44%	3%	2%
30	Textiles/leather	1,943	1%	55%	45%	< 1%	0%
37	Transport equip.	1,899	1%	4%	88%	8%	< 1%
6	Milled grain prods.	1,867	1%	15%	78%	1%	6%

40	Misc. mfg. prods.	1,574	1%	36%	64%	0%	0%
22	Fertilizers	1,385	< 1%	7%	68%	10%	16%
13	Nonmetallic minerals	1,255	< 1%	21%	38%	19%	22%
23	Chemical prods.	1,170	< 1%	22%	75%	2%	< 1%
28	Paper articles	979	< 1%	9%	91%	0%	0%
99	Unknown	851	< 1%	64%	36%	0%	< 1%
33	Articles-base metal	798	< 1%	36%	60%	< 1%	4%
5	Meat/seafood	693	< 1%	17%	84%	0%	0%
39	Furniture	589	< 1%	71%	29%	0%	0%
34	Machinery	508	< 1%	50%	47%	3%	< 1%
14	Metallic ores	443	< 1%	0%	95%	0%	5%
11	Natural sands	434	< 1%	1%	92%	6%	< 1%
35	Electronics	240	< 1%	47%	53%	0%	0%
18	Fuel oils	231	< 1%	47%	48%	3%	3%
29	Printed prods.	98	< 1%	23%	76%	0%	< 1%
25	Logs	84	< 1%	1%	91%	8%	0%
38	Precision instruments	38	< 1%	97%	3%	0%	0%
9	Tobacco prods.	0.4	< 1%	0%	100%	0%	0%
	TOTAL	**160,646**	**100%**	**32%**	**59%**	**7%**	**3%**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

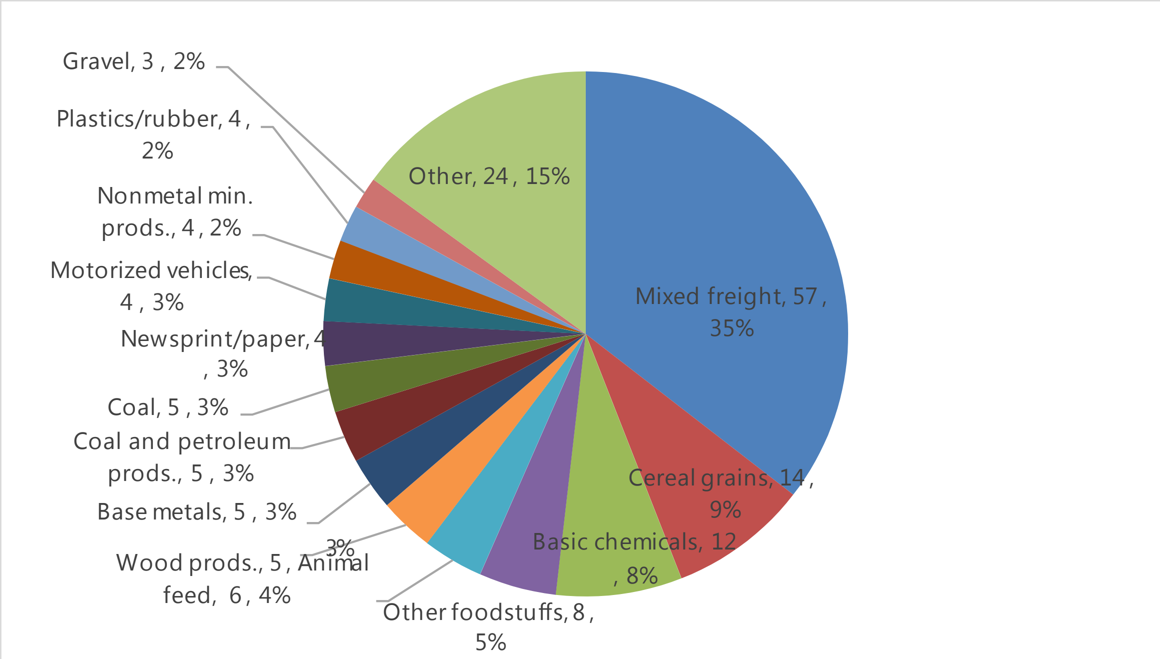


Exhibit 2: California's Top Rail Commodities (in millions of tons), All Traffic, 2013

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

The mixed freight commodity category contains virtually all kinds of freight that can be moved in a trailer or container and is not reported as a specific commodity[5]. The primary commodities handled in this manner consist of consumer goods, including packaged foods, electronics, office supplies, and durable goods, along with a broad range of intermediate components for manufacturing, such as auto parts. Cereal grains include field crops such as wheat, corn, rye, barley, and oats. Basic chemicals are comprised of two categories, inorganic chemicals and organic chemicals. There are dozens of inorganic chemicals, such as chlorine, sodium sulfates, hydrochloric acid, and others, that can be shipped by rail. On the other hand, there are nine sub-types of organic chemicals, including phenols, organic dyes and pigments, and cyclic hydrocarbons. The fourth-most significant commodity group in California, other foodstuffs, contains seven sub-categories. This includes dairy products (i.e. milk, cream, cheese), processed or prepared vegetables, fruit, nuts, or juices (i.e. potato chips, jellies), coffee/tea/spices, animal or vegetable fats, sugar and cocoa preparations, and non-alcoholic beverages. Finally, animal feed contains other types of food products for consumption by animals. This includes products such as inedible flours, oil cake, and dog/cat food.

In comparison to the 2013 CSRP, there are a few notable changes among the top commodities. Although mixed freight and cereal grains were the two most commonly transported goods in

[5] Approximately 20 percent of traffic moving intermodally is reported with a specific commodity rather than mixed freight. This is a requirement for hazmat commodities, while for non-hazmat shipments specific commodity reporting is determined by commercial considerations.

the last analysis, basic chemicals more than doubled in tonnage during that period. Additionally, motorized vehicles declined from over 6.6 million tons in 2007, and wood products declined from 8.5 million tons. However, the transport of animal feed increased significantly during this period.

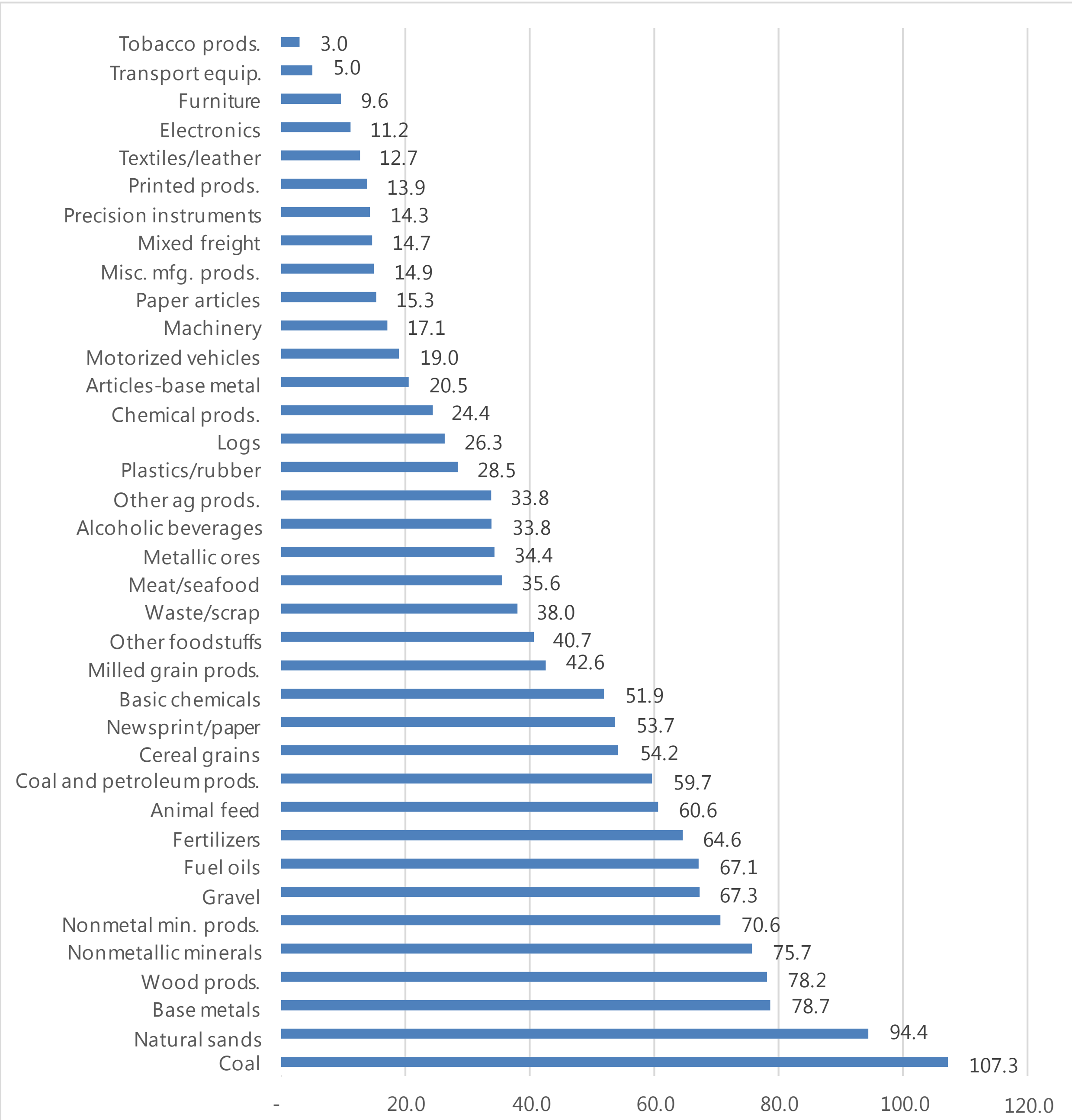


Exhibit 3: Tons per Unit per Commodity Shipped in California, All Directions, 2013

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

Exhibit 3 shows the number of tons shipped per unit overall for each commodity type in 2013. For carload service, a unit typically represents a railcar, while for intermodal service a unit represents a container or highway trailer. Thus, commodities with the fewest tons per unit, including tobacco, transportation equipment and furniture, are largely shipped in containers and trailers, and thus have a natural limit of around 18 tons to avoid being classified as overweight shipments. Coal, ranked ninth in terms of tonnage, had the highest number of tons per carload. Similarly, natural sands is one of the least shipped commodities in California ton-wise, but it is has the second highest number of tons per carload. These notably dense and heavy products are usually moved in bulk.

Top Trading Partners

Trade Regions beyond California

California's rail-based trading partners include various regions throughout the United States, Canada, and Mexico, as shown in Table 3. California's top five trading regions overall are as follows: East North Central, West South Central, West North Central, Mountain, and East South Central. For inbound commodities, California receives the highest number of tons from the East North Central region of the U.S., which includes the states of Illinois, Indiana, Michigan, Ohio, and Wisconsin. In 2013, California accepted nearly 26 million tons of goods from this region. The West North Central region is also an important region, and comprises 24 percent of inbound commodities. This area includes the states of Iowa, Kansas, Minnesota, Missouri, North Dakota, South Dakota, and Nevada. For outbound shipments, California sends 37 percent of all goods to East North Central, and 29 percent to West South Central, which includes the states of Louisiana, Oklahoma, Texas, and Arkansas. Exhibit 4 provides a visualization of total tonnage shipped to and from California to regions throughout North America. To highlight individual states, California's trade with Illinois is highest in all directions, followed by Texas. Total trade by rail with Illinois represents nearly 30 percent of all commodity tonnage, and 17 percent of tonnage with Texas.

Table 3: California's Top Trading Regions by Rail, 2013

Region	Total		Inbound		Outbound	
	Tons (millions)	% of Total	Tons (millions)	% of Total	Tons (millions)	% of Total
East North Central	44.8	47%	25.9	28%	18.9	37%
West South Central	32.6	35%	17.8	19%	14.8	29%
West North Central	26.2	28%	22.5	24%	3.6	7%
Mountain	15.8	17%	12.4	13%	3.4	7%
East South Central	7.4	8%	4.1	4%	3.4	7%
Pacific	6.8	7%	4.6	5%	2.2	4%
South Atlantic	5.3	6%	2.4	3%	2.9	5%
Canada	4.0	4%	3.6	4%	0.4	< 1%
Middle Atlantic	2.1	2%	0.6	< 1%	1.4	3%
New England	0.4	< 1%	0.1	< 1%	0.3	< 1%
Mexico	0.1	< 1%	0.1	< 1%	0.0	< 1%
TOTAL	**145.4**	**100%**	**94.1**	< 1%	**51.4**	**100 %**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

For many regions, the top inbound/outbound commodity is mixed freight, particularly the regions of East North Central, East South Central, New England, and West South Central. Cereal grains transported to California from the West North Central region comprise the highest amount of tonnage after mixed freight, with over 8.5 million tons in 2013. Coal from the Mountain region is also a significant California import; 4.5 million tons were shipped into the state in 2013. Finally, basic chemicals and animal feed are two other important imports from the West North Central region, which were transported in excess of 3.9 million and 3.2 million tons, respectively. On the outbound side, California ships high amounts of other food stuffs (1.4 million tons) and other agricultural products (970,000 tons) to East North Central, and high amounts of basic chemicals (718,000 tons) and motorized vehicles (590,000 tons) to the West South Central region. Overall, top inbound commodities in 2013 were 68 percent greater than outbound commodities, with over 43 million tons shipped outbound compared to 72.4 million tons shipped inbound.

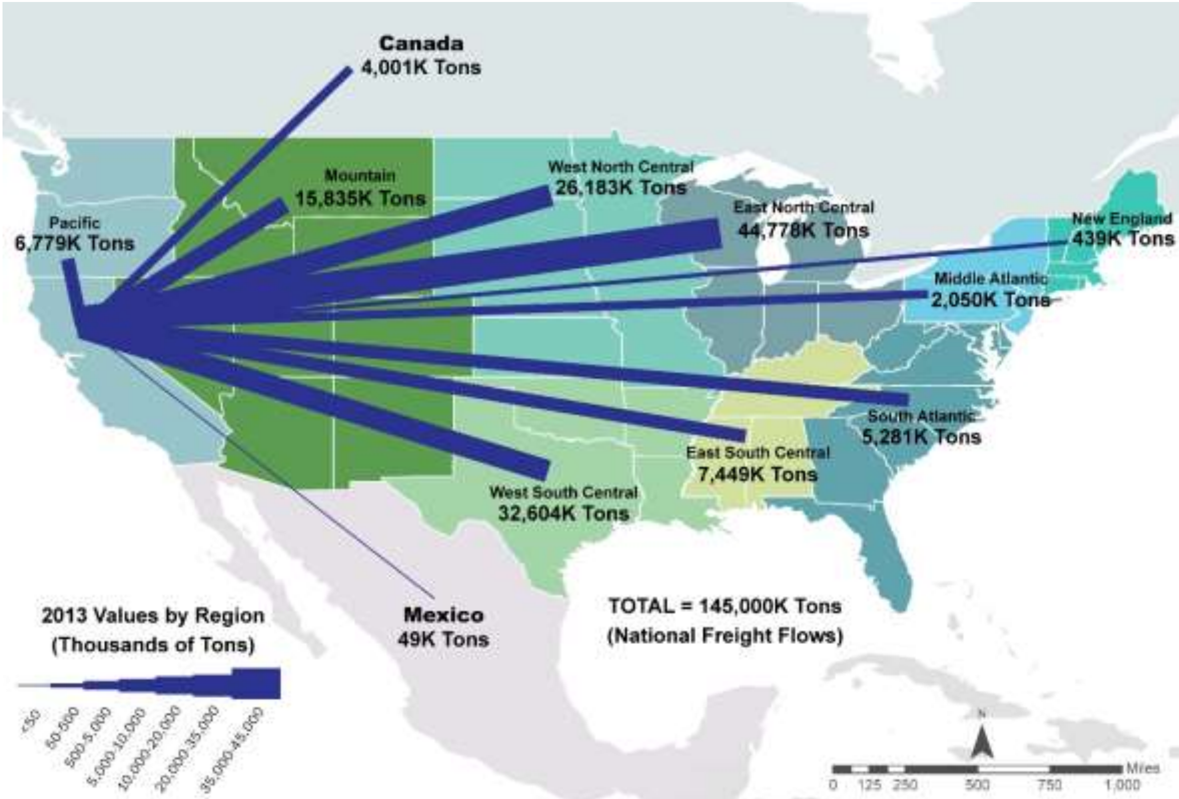


Exhibit 4: California Tail Trading Partner Tonnage Distribution

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

Table 4 provides more detail on the breakdown of the top 5 regions per rail service type by tonnage between California and other trade regions throughout the United States, Canada, and Mexico. There is a clear mix of carload and intermodal traffic within each region depending on the direction of flow. The East North Central region – which includes Chicago, the single largest rail hub in North America - has the highest percentages of intermodal traffic traveling both inbound and outbound California. Additionally, coal, coke, iron ore, and bulk grain cargo is shipped to California primarily from the Mountain and West North Central Regions and shipped from California to several U.S. regions, but the largest proportion goes to West South Central.

Table 4: Top 5 Regions by Service Type and Tonnage, 2013

Service Type	Outbound			Inbound		
	Region	Tons (millions)	% of Region Total	Region	Tons (millions)	% of Region Total
All Other Traffic	East North Central	2.4	13%	West North Central	9.6	42%
	Mountain	2.3	69%	West South Central	6.8	38%
	West South Central	2.0	14%	Mountain	5.8	47%
	Pacific	1.3	59%	Pacific	4.2	91%
	East South Central	0.7	21%	Canada	3.5	98%
Intermodal	East North Central	16.3	86%	East North Central	23.2	90%
	West South Central	12.2	82%	West South Central	10.4	59%
	West North Central	2.9	79%	West North Central	4.7	21%
	East South Central	2.6	76%	East South Central	2.4	58%
	South Atlantic	2.4	82%	South Atlantic	1.9	80%
Coal, coke, iron ore, and bulk grain	West South Central	0.1	< 1%	West North Central	7.8	35%
	Mountain	0.1	2%	Mountain	5.6	45%
	East South Central	0.1	2%	West South Central	0.2	1%
	Canada	0.0	12%	Pacific	0.1	2%
	Pacific	0.0	2%	Canada	0.1	2%
Assembled motor vehicles	West South Central	0.5	3%	East North Central	1.1	4%
	East North Central	0.2	< 1%	East South Central	0.5	12%
	Mountain	0.1	3%	West North Central	0.4	2%
	West North Central	0.1	2%	West South Central	0.4	2%
	Pacific	0.1	3%	Mountain	0.1	< 1%

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

Table 5 details the number of units for the top five regions for each service type. As in the prior table, the East North Central region has the highest share of its traffic traveling intermodally both inbound and outbound California, reaching upwards of 95 percent and 97 percent of all intermodal activity, respectively. However, four other regions – West South Central, West North Central, East South Central, and South Atlantic – all receive over 94 percent of their unit volume from California intermodally.

Table 5: Top 5 Regions by Service Type and Units, 2013

Service Type	Outbound			Inbound		
	Region	Units (thousands)	% of Region Total	Region	Units (thousands)	% of Region Total
All Other Traffic	East North Central	30.9	3%	West North Central	101.5	23%
	Mountain	27.5	25%	West South Central	84.2	10%
	West South Central	24.6	2%	Mountain	64.7	30%
	Pacific	16.0	22%	Pacific	45.5	58%
	East South Central	9.3	4%	Canada	36.3	96%
Intermodal	East North Central	1,221.0	97%	East North Central	1,302.8	95%
	West South Central	953.3	95%	West South Central	762.1	88%
	West North Central	222.1	95%	West North Central	246.9	56%
	East South Central	209.2	95%	East South Central	155.5	81%
	South Atlantic	183.8	97%	South Atlantic	127.0	95%
Coal, coke, iron ore, and bulk grain	West South Central	1.3	< 1%	West North Central	74.4	17%
	East South Central	0.6	< 1%	Mountain	61.3	29%
	Mountain	0.6	< 1%	West South Central	1.6	< 1%
	Canada	0.5	5%	Pacific	1.0	1%
	Pacific	0.4	< 1%	Canada	0.8	2%
Assembled motor vehicles	West South Central	24.9	3%	East North Central	49.5	4%
	East North Central	7.2	< 1%	East South Central	22.0	12%
	Mountain	4.8	4%	West North Central	21.1	5%
	West North Central	3.9	2%	West South Central	18.5	2%
	Pacific	2.9	4%	Mountain	1.9	< 1%

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

Trade Regions within California

California can be categorized as having eight distinct regions of trade activity, as presented in Exhibit 5. Some regions are more freight intensive than others depending on the existence of ports, rail hubs, major cities, and intermodal facilities. Exhibit 6 details the outbound and inbound commodity volumes for each of the eight California regions. Four of the regions consist of major cities and economic hubs –San Francisco Bay Area, Sacramento, Southern California, and San Diego – while the remaining regions are based on geographical areas, including the Central Coast California, Central Valley, and Eastern California. For both inbound and outbound shipments, the Southern California region comprises the majority of traffic at 63 percent and 68 percent, respectively. In total, over 62 million tons of commodities were transported outbound and 104.7 million tons of goods were transported into California in 2013.

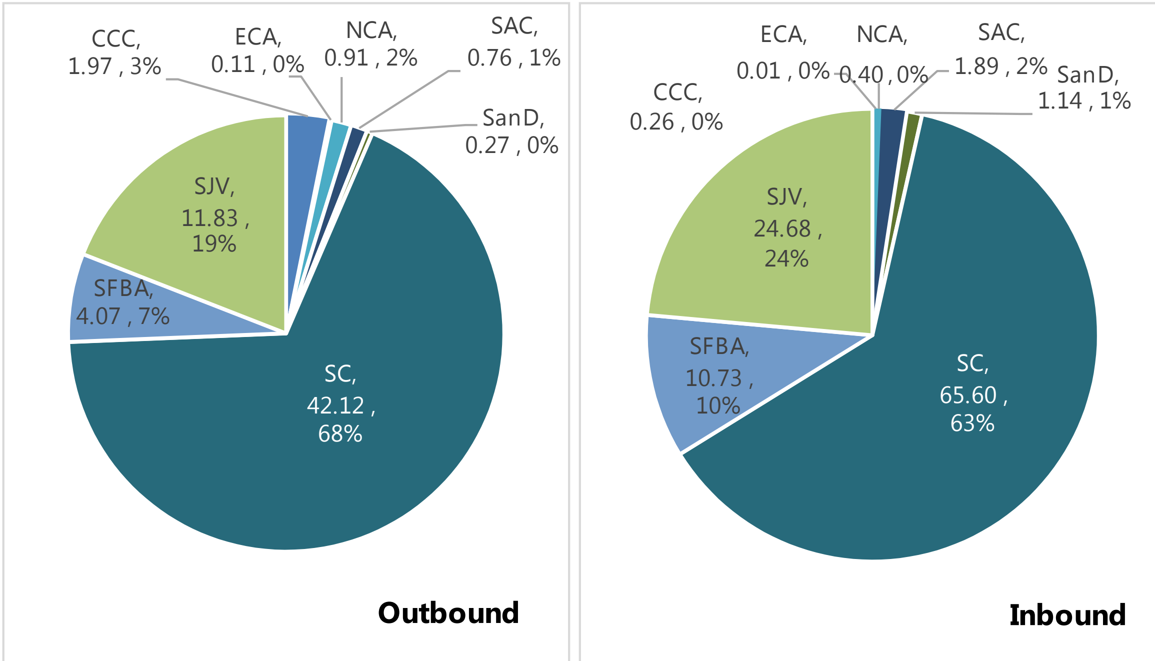


Exhibit 5: Trade Activity by Tons in California's 8 Regions, All Traffic, 2013

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

Note: CCC = Central Coast California; ECA = Eastern California; NCA = Northern California; SAC = Sacramento; SanD = San Diego; SC = Southern California; SFBA = San Francisco Bay Area; SJV = Central Valley.

Exhibit 6: California's 8 Trade Regions

Source: Cambridge Systematics

There is also a significant amount of trade activity occurring within and between each of the eight regions of California, totaling over 10.6 million tons in 2013. Table 6 shows a matrix of trade flows between and within each of these regions. The Southern California region continues to be an important area of California with respect to intrastate trade.

Table 6: Intra-State Commodity Flow (in thousands of tons) between California's 8 Regions, All Traffic, 2013

		Termination Region								
		CCC	ECA	NCA	SAC	SanD	SOUTHERN CALIFORNIA	SFBA	SJV	TOTAL
Origin Region	CCC	3.7	0.0	0.0	0.0	0.0	633.7	1,200.8	0.0	**1,838.2**
	ECA	0.0	0.0	0.0	0.0	0.0	8.0	0.0	73.1	**81.1**
	NCA	0.0	0.0	0.0	141.1	0.0	13.1	0.8	50.1	**205.1**
	SAC	0.0	0.0	0.0	2.8	0.0	21.7	54.4	7.5	**86.3**
	SanD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
	SC	17.7	4.2	16.1	341.3	166.7	4,463.1	415.1	696.0	**6,120.2**
	SFBA	0.0	0.0	68.1	45.7	14.8	417.7	47.0	254.2	**847.5**
	SJV	8.8	5.0	12.2	12.1	39.7	665.5	340.5	393.6	**1,477.2**
	TOTAL	**30.2**	**9.2**	**96.3**	**543.0**	**221.2**	**6,222.9**	**2,058.5**	**1,474.4**	**10,655.7**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

Note: CCC = Central Coast California; ECA = Eastern California; NCA = Northern California; SAC = Sacramento; SanD = San Diego; SC = Southern California; SFBA = San Francisco Bay Area; SJV = Central Valley.

Exhibit 7 and Exhibit 8 show 2013 county-level origination and termination tonnage in California. The vast majority of tonnage flows in and out of Los Angeles County, CA, 46 percent of inbound commodities and 60 percent of outbound commodities. The ports of Los Angeles and Long Beach drive much of this traffic as the two largest container ports in the country. After Los Angeles, San Bernardino and San Joaquin counties also have a significant amount of inbound and outbound commodity traffic, comprising around 10 percent for each county in each direction. Located east of Los Angeles, San Bernardino County has become a major distribution hub for all of Southern California. San Joaquin County, which is east of San Francisco, serves the Bay Area in a similar capacity, along with having major local industries. The Port of Stockton features warehouse storage and handling facilities for both dry and liquid bulk materials. The Port also handles break-bulk and containerized cargoes by both land and sea modes, resulting in significant carload activity.

Exhibit 7: Terminating Tonnage in California by County, 2013

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

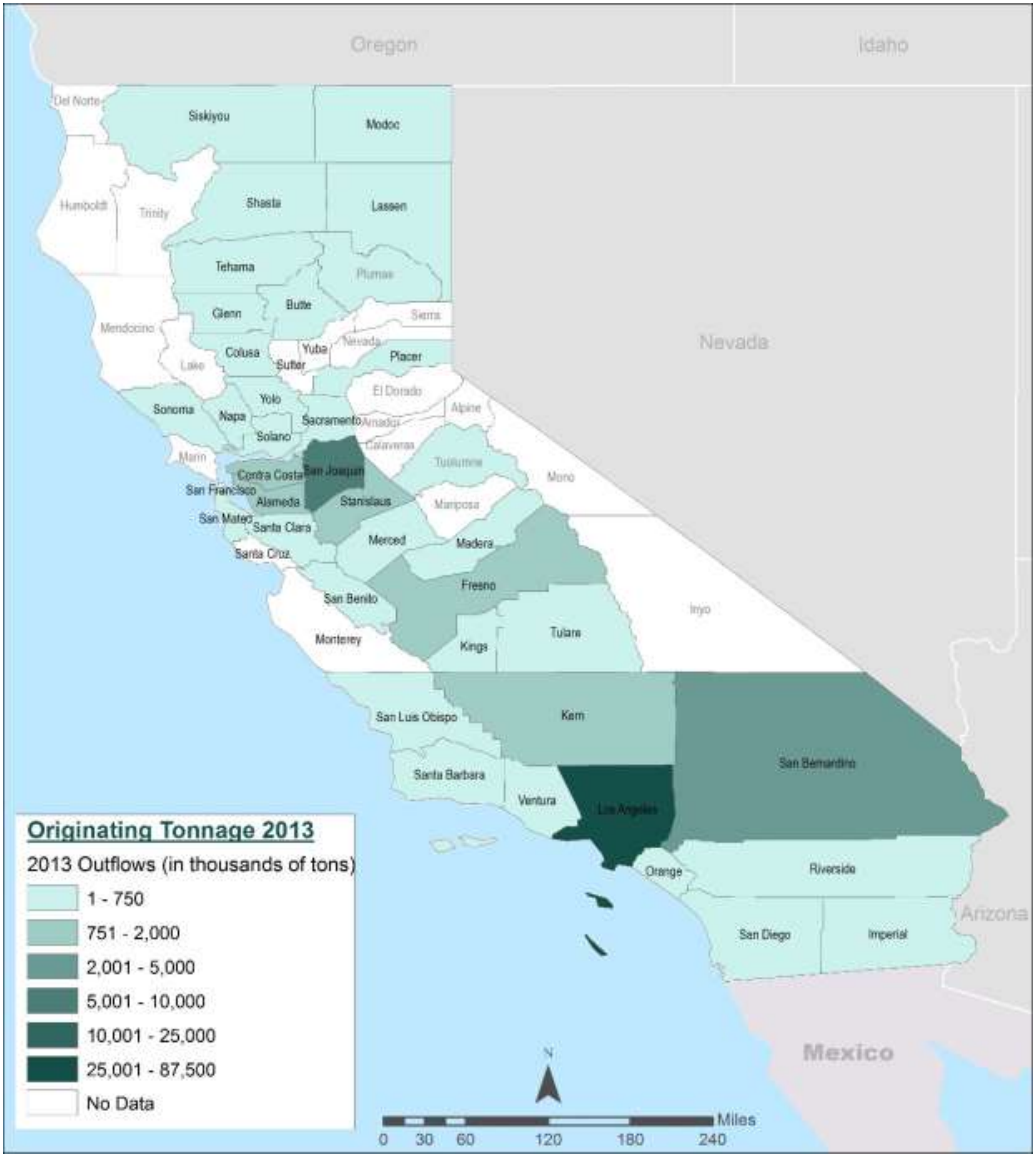


Exhibit 8: Originating Tonnage in California by County, 2013

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

2040 Rail Volumes

As shown in Exhibit 9, roughly 15.2 million units carrying 319 million tons of commodities are projected to move by rail in California in 2040. Overall, commodities shipped by rail in California are projected to achieve a CAGR of 2.6 percent between 2013 and 2040. Inbound goods are expected to comprise 54 percent of total tonnage and 43 percent of total units. Outbound goods are expected to comprise 38 percent of total tonnage and 55 percent of total units. About 14.8 million tons are projected to move between origins and destinations within California ("CA Local"), and 7.6 million tons are projected to travel through the State without stopping ("CA Through"). Outbound goods have the highest compound annual growth rate (CAGR) of all flows at 3.3 percent between 2013 and 2040, followed by inbound goods (2.3 percent), CA Through goods (1.9 percent), and CA Local goods (1.2 percent).

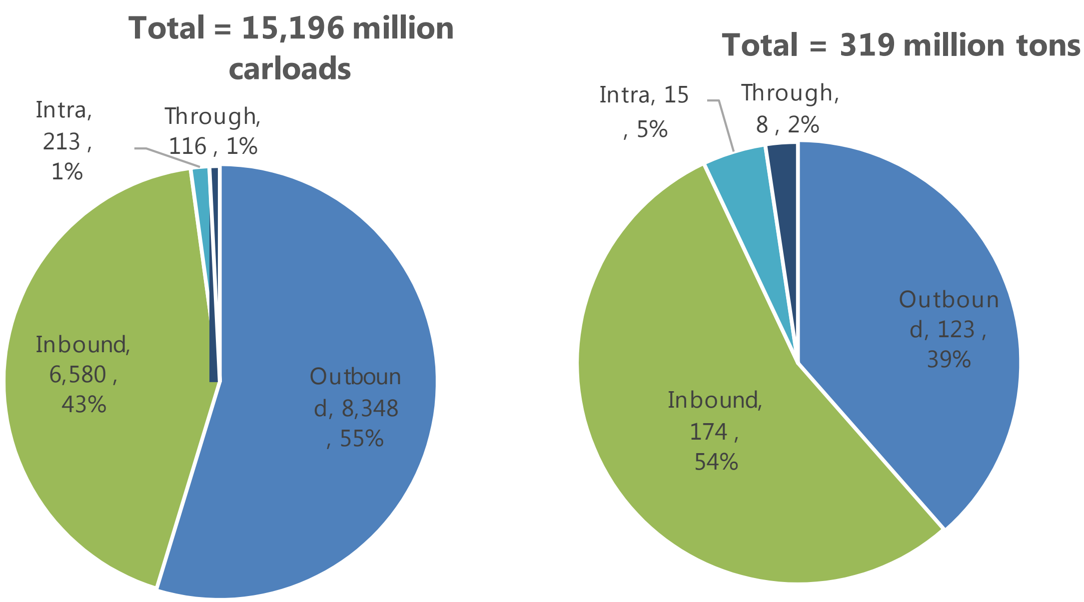


Exhibit 9: California Rail based Total Units (in thousands) and Tons (in millions), 2040

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

In 2040, more units are anticipated to travel outbound versus inbound in California, as presented in Exhibit 9. However, inbound tonnage is expected to be higher than outbound tonnage, reflecting a different commodity mix and a greater portion of commodities moving in railcars versus containers and trailers.

Table 7 summarizes the forecasted carload and intermodal activity in California. Intermodal movements comprise the bulk of rail activity projected for California in 2040, 89 percent of total units and 60 percent of total tonnage. The share of units and tons traveling intermodally has increased notably from 2013.

Table 7: California Rail based Units and Tons by Rail Service Type, 2040

Service Type	2040 Units (millions)	% of Total Units	2040 Tons (millions)	% of Total Tons	CAGR Total Units	CAGR Total Tons
Carload	1.6	11%	127.4	40%	1.9%	1.9%
Intermodal	13.6	89%	191.9	60%	3.2%	3.1%
Total	**15.2**	**100%**	**319.3**	**100%**		

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

To further illustrate the proportion of intermodal versus carload activity, Exhibit 10 depicts the share by type from 2013 to 2040 in terms of units and tonnage. Since the 2008 recession, sectors that have traditionally generated demand for carload rail service in California – such as construction and manufacturing – have exhibited low and uneven growth. Thus the share of traffic traveling intermodally in terms of units and tonnage is expected to continue to increase from the already high levels seen in 2013. This growth is expected to be driven by continued increases in international traffic, and a shift in commodity mix that favors intermodal over carload service.

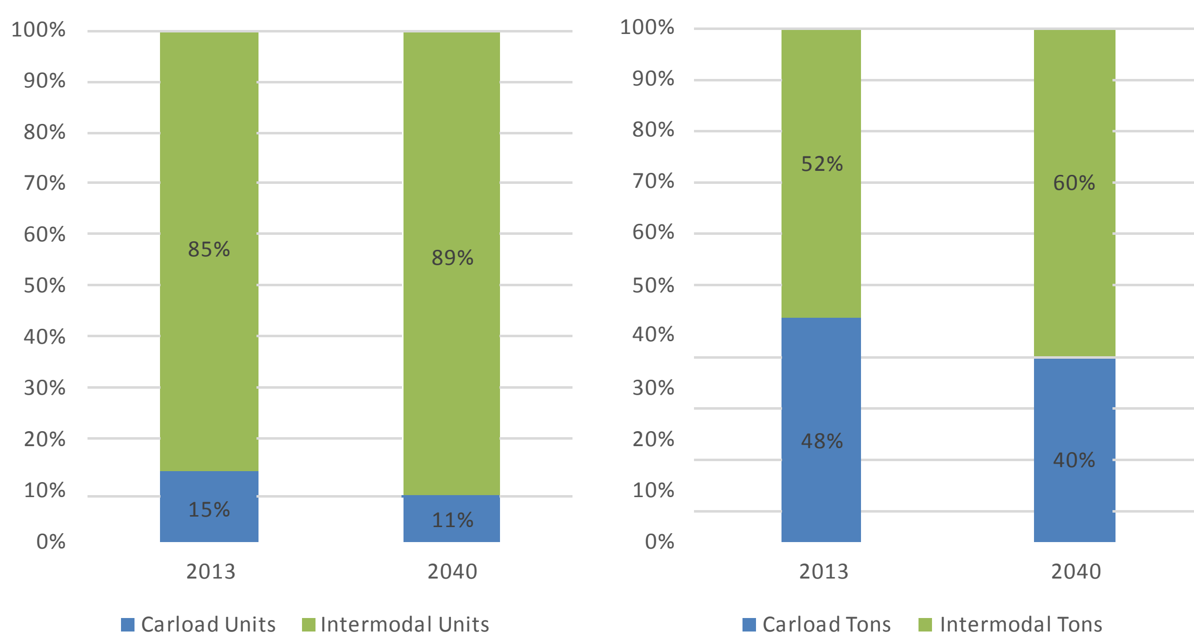


Exhibit 10: California Splits by Rail Service Type, Units (left) and Tons (right)

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

This analysis also found that the annual growth rate for carload service to be roughly the same for units and tonnage, roughly 1.9 percent, as shown in Table 7. The annual growth rate for intermodal service is significantly higher, 3.2 percent for units and 3.1 percent for tonnage. This finding suggests stronger growth for intermodal freight activity throughout California through its rail system.

Forecasted Top Commodities

By far, mixed freight comprises the largest share of total tonnage by commodity at 45 percent as shown in Exhibit 11. This category includes almost any commodity that can be moved in a container or trailer, and commonly covers most consumer goods, packaged foods, intermediate manufactured goods (such as auto parts) as well as some packaged bulk materials (such as bagged cement). In California, international trade and the state's sizeable population have driven the growth of this traffic to its present dominance, a trend that is expected to continue through 2040.

Collectively, agricultural products (e.g. cereal grains, other foodstuffs, animal feed, and other agricultural products, among others) comprise a significant share of total tonnage on the California rail system. Given the prominence of the Central Valley as an agricultural region, it is intuitive that agriculture would represent an important industry sector to freight rail. Together, agricultural products represent more than 17 percent of total tonnage. A few of the common items shipped in this category include basic crops (such as wheat, corn, rye, barley, and oats), dairy products, vegetables, fruits, nuts, animal or vegetable fats, sugar and cocoa preparations, and non-alcoholic beverages.

Other commodity groups with significant tonnages on the California rail system include basic, assembled motorized vehicles, plastics/rubber, base metal, coal and petroleum products, non-metal mineral products, and newsprint/paper. Many of these commodities represent raw products that may be inputs to manufacturing processes while others (namely motor vehicles and newsprint/paper) are the outputs of those processes. The significant presence of these commodity groups along with mixed freight highlight the importance of California's manufacturing sector to the rail system.

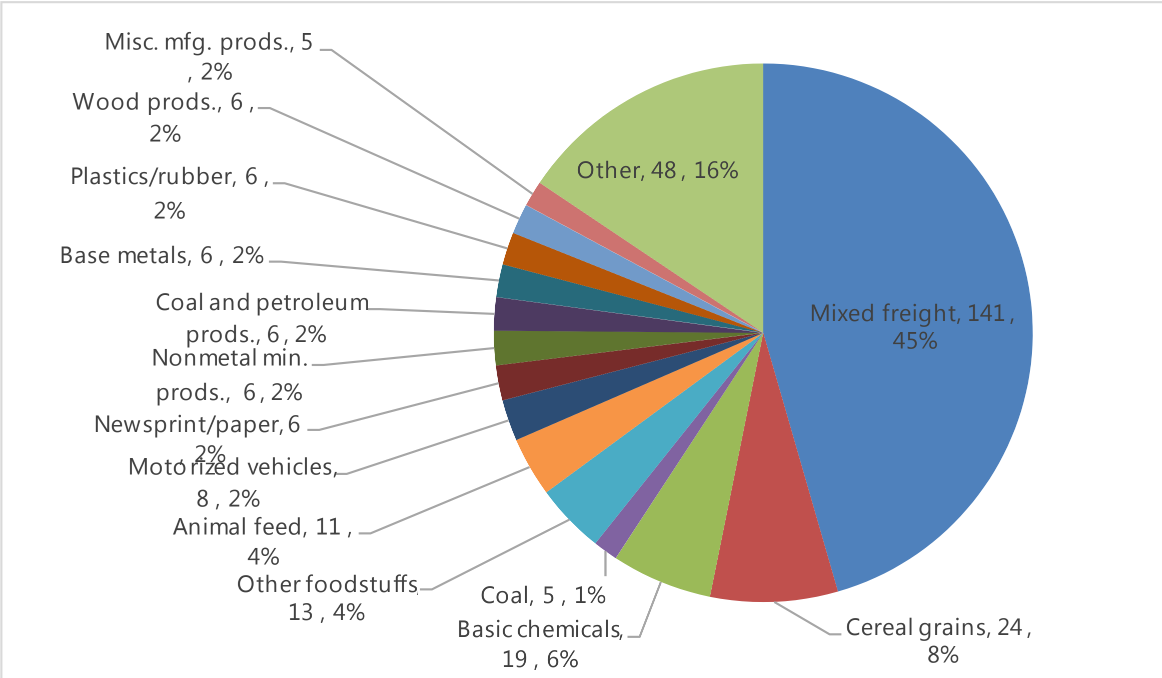


Exhibit 11: California's Top Rail Commodities (in millions of tons), All Traffic, 2040

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Exhibit 12 shows that mixed freight is projected to dominate the distribution of commodities on California's freight rail system in terms of units in addition to tonnage. By units, mixed freight comprises about 65 percent of total traffic. The collective of agricultural products (e.g. cereal grains, other foodstuffs, animal feed, and other agricultural products, among others) similarly represent a significant share of both freight rail traffic and tonnage. By units, agricultural products comprise about 7 percent of rail traffic. Other prominent commodity groups include basic chemicals, assembled motor vehicles, textiles/leather, plastics/rubber, coal and petroleum products, and furniture, among others.

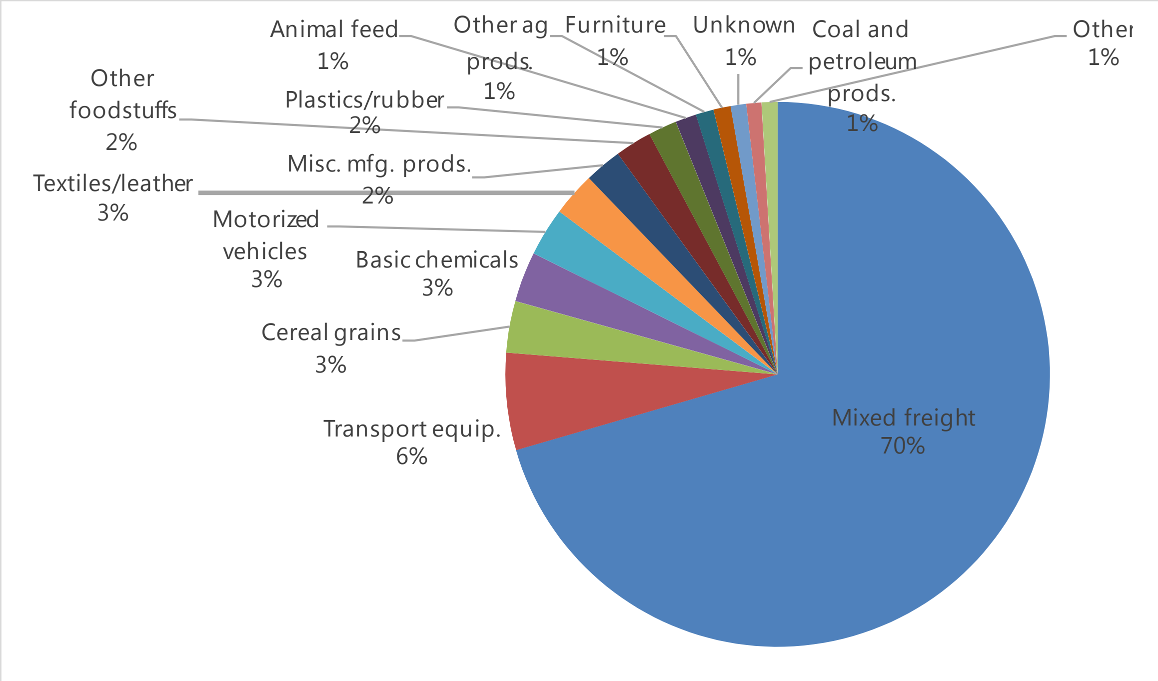


Exhibit 12: California's Top Rail Commodities (in units), All Traffic, 2040

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

As noted previously, the reason for the change in commodity distribution when a unit, as opposed to tonnage, perspective is taken lies in the typical equipment used and commodity density. Commodities moving primarily in bulk, such as grain, coal and chemicals, are commonly shipped in railcars with a capacity of 80 or more tons, while manufactured goods are largely shipped in containers and trailers with a maximum capacity of around 20 tons. To handle an equivalent amount of volume in a trailer or container as is available in a railcar requires anywhere from 3 to 5 units. Thus, while dense commodities such as coal account for a greater share of tonnage, commodities moving in intermodal service are more prevalent in terms of traffic volumes on California's rail network.

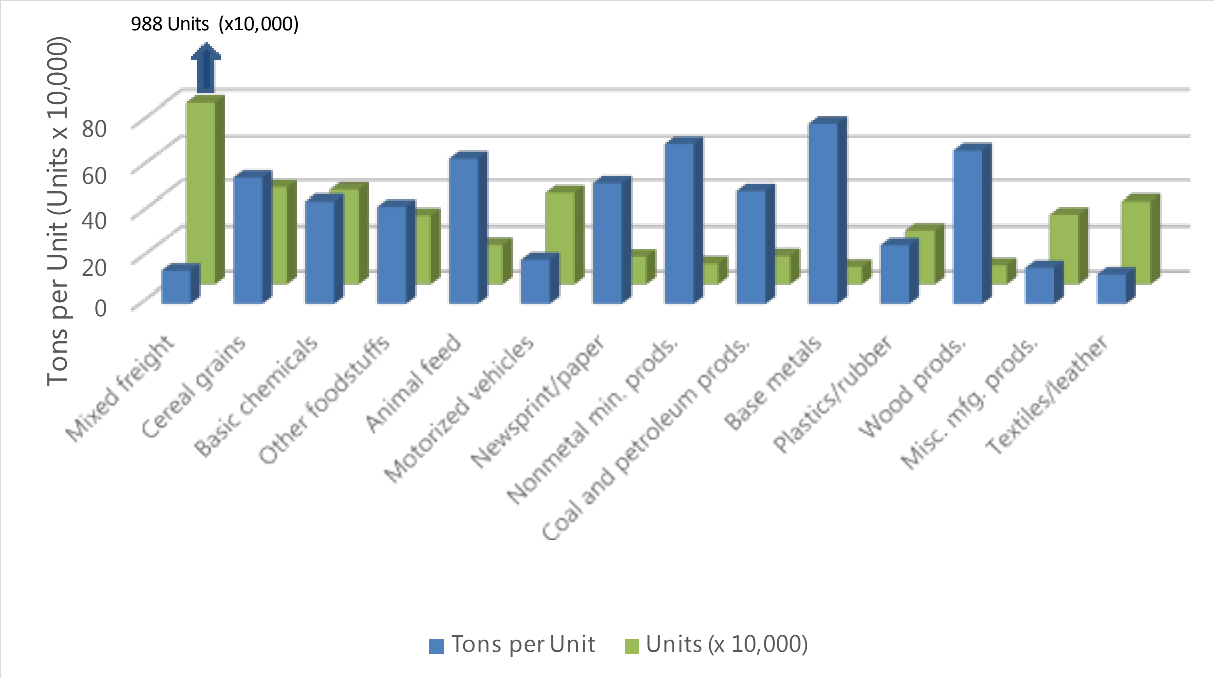


Exhibit 13: Ton-to-Carload Ratios for Various Commodities, 2040

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Traffic by Direction of Movement

In terms of total tonnage, inbound commodities comprise a larger share of freight volume on the California rail system by direction – about 53 percent. The primary reason for this is that the directional distribution of particularly dense, heavy commodities such as coal, metallic ores, and natural sands are largely skewed towards the inbound direction. On the other hand, lighter, higher-value commodities such as alcoholic beverages, textiles/leather, and precision instruments are skewed in the outbound direction. In total, outbound commodities comprise about 40 percent of total tonnage. Much of this traffic is associated with imports from Asia, along with specialty goods – such as wine – that are produced in the state.

Internal and through movements constitute relatively small shares of freight rail volume by direction – about 5 and 2 percent, respectively. Bulk commodities such as gravel, non-metallic minerals, and base metals comprise large shares of these movements.

When viewed from the perspective of traffic volumes, as opposed to tonnage, outbound shipments comprise the largest share of units on the California rail system – about 55 percent. Inbound shipments are the next largest share at 43 percent. The reason for the difference between the most prevalent commodities when viewed from a unit as opposed to tonnage perspective is, again, the importance of California's ports serving as a gateway to Asian trade, most of which moves in containers.

Table 8: California Rail based Tons by SCTG-2 Digit Commodity Type, 2040

SCTG Code	SCTG Commodity	Tons (in thousands) by Commodity and Percentage Distribution by Direction					
		All Directions	% of Total	O/B	I/B	IN	THRU
43	Mixed freight	141,148	46%	62%	38%	< 1%	< 1%
02	Cereal grains	23,708	8%	3%	95%	< 1%	< 1%
20	Basic chemicals	18,767	6%	21%	64%	12%	3%
07	Other foodstuffs	13,007	4%	47%	48%	3%	2%
04	Animal feed	11,100	4%	3%	94%	3%	2%
36	Motorized vehicles	7,686	3%	28%	60%	0%	12%
27	Newsprint/paper	6,493	2%	2%	89%	4%	6%
31	Nonmetal min. prods.	6,428	2%	19%	38%	37%	6%
19	Coal and petroleum prods.	6,173	2%	24%	42%	29%	5%
32	Base metals	6,106	2%	13%	60%	22%	6%
24	Plastics/rubber	6,081	2%	24%	67%	3%	7%
26	Wood prods.	5,626	2%	9%	59%	< 1%	33%
40	Misc. mfg. prods.	4,775	2%	28%	72%	0%	0%
30	Textiles/leather	4,604	2%	60%	39%	< 1%	0%
15	Coal	4,596	2%	0%	98%	0%	2%
12	Gravel	4,594	2%	< 1%	2%	98%	0%
03	Other agricultural prods.	4,564	2%	63%	33%	2%	2%
37	Transport equip.	4,257	1%	5%	89%	5%	< 1%
41	Waste/scrap	4,216	1%	22%	63%	3%	12%
08	Alcoholic beverages	4,170	1%	66%	32%	0%	3%
06	Milled grain prods.	2,843	< 1%	16%	78%	1%	5%
23	Chemical prods.	2,738	< 1%	27%	70%	2%	< 1%
22	Fertilizers	2,475	< 1%	6%	76%	7%	12%
13	Nonmetallic minerals	2,093	< 1%	23%	40%	18%	20%
28	Paper articles	1,632	< 1%	10%	90%	0%	0%
99	Unknown	1,403	< 1%	68%	32%	0%	0%
34	Machinery	1,384	< 1%	57%	39%	4%	< 1%

14	Metallic ores	1,353	< 1%	0%	98%	0%	2%
33	Articles-base metal	1,337	< 1%	35%	60%	< 1%	4%
39	Furniture	1,332	< 1%	80%	21%	0%	0%
05	Meat/seafood	1,319	< 1%	22%	78%	0%	0%
11	Natural sands	858	< 1%	< 1%	97%	2%	< 1%
35	Electronics	496	< 1%	51%	49%	0%	0%
18	Fuel oils	226	< 1%	43%	51%	4%	2%
38	Precision instruments	203	< 1%	99%	< 1%	0%	0%
29	Printed prods.	132	< 1%	24%	76%	0%	< 1%
25	Logs	116	< 1%	1%	90%	9%	< 1%
09	Tobacco prods.	0.3	< 1%	0%	100%	0%	0%
	TOTAL	**160,646**	**100%**	**32%**	**59%**	**7%**	**3%**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample

Table 9: California Rail based Units by SCTG-2 Digit Commodity Type, 2040

SCTG Code	SCTG Commodity	Units by Commodity and Percentage Distribution by Direction					
		All Directions	% of Total	O/B	I/B	IN	THRU
43	Mixed freight	9,877,126	65%	69%	31%	< 1%	0%
37	Transport equip.	806,665	5%	3%	94%	3%	< 1%
02	Cereal grains	428,586	3%	2%	97%	< 1%	< 1%
20	Basic chemicals	417,881	3%	34%	60%	5%	1%
36	Motorized vehicles	403,102	3%	33%	58%	0%	10%
30	Textiles/leather	366,831	2%	64%	36%	< 1%	0%
40	Misc. mfg. prods.	308,465	2%	33%	66%	0%	< 1%
07	Other foodstuffs	305,072	2%	53%	45%	1%	< 1%
24	Plastics/rubber	237,958	2%	40%	58%	< 1%	2%
04	Animal feed	174,299	1%	3%	90%	5%	1%
03	Other ag prods.	149,357	1%	70%	29%	< 1%	< 1%
39	Furniture	143,411	< 1%	84%	16%	0%	0%
99	Unknown	129,871	< 1%	68%	33%	0%	0%
19	Coal and petroleum prods.	125,260	< 1%	35%	43%	19%	3%

27	Newsprint/paper	122,908	< 1%	2%	92%	3%	4%
41	Waste/scrap	107,754	< 1%	25%	68%	2%	6%
08	Alcoholic beverages	105,020	< 1%	60%	37%	0%	3%
23	Chemical prods.	104,103	< 1%	28%	71%	< 1%	< 1%
28	Paper articles	103,219	< 1%	12%	88%	0%	0%
31	Nonmetal min. prods.	91,513	< 1%	20%	52%	24%	5%
26	Wood prods.	83,580	< 1%	17%	60%	0%	23%
32	Base metals	77,048	< 1%	14%	64%	17%	5%
34	Machinery	73,027	< 1%	65%	34%	< 1%	< 1%
06	Milled grain prods.	67,675	< 1%	27%	70%	< 1%	3%
12	Gravel	66,850	< 1%	< 1%	3%	97%	0%
33	Articles-base metal	59,666	< 1%	31%	68%	< 1%	1%
35	Electronics	42,613	< 1%	51%	49%	0%	0%
15	Coal	38,287	< 1%	0%	98%	0%	2%
14	Metallic ores	37,118	< 1%	0%	99%	0%	< 1%
22	Fertilizers	36,370	< 1%	17%	71%	4%	8%
05	Meat/seafood	34,739	< 1%	45%	55%	0%	0%
13	Nonmetallic minerals	29,052	< 1%	25%	46%	13%	16%
38	Precision instruments	13,883	< 1%	99%	< 1%	0%	0%
29	Printed prods.	10,058	< 1%	31%	69%	0%	< 1%
11	Natural sands	8,940	< 1%	2%	96%	2%	< 1%
25	Logs	4,329	< 1%	1%	96%	3%	0%
18	Fuel oils	3,827	< 1%	29%	67%	3%	2%
09	Tobacco prods.	95	< 1%	0%	100%	0%	0%
	TOTAL	**15,195,555**		**55%**	**43%**	**1%**	**1%**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Top Trading Partners in 2040

Trade Regions beyond California

California's rail-based trading partners are projected to include various regions throughout the United States, Canada, and Mexico, as shown in Table 10. California's top five trading regions overall include the same regions from 2013: East North Central, West South Central, West North Central, Mountain, and East South Central. For inbound commodities, California is expected to receive the highest number of tons from the East North Central region of the U.S., which includes the states of Illinois, Indiana, Michigan, Ohio, and Wisconsin. In 2040, California is projected to receive nearly 52 million tons of goods from this region. The West North Central region is also an important region, and comprises 22 percent of inbound commodities. This area includes the states of Iowa, Kansas, Minnesota, Missouri, North Dakota, South Dakota, and Nevada. For outbound shipments, California sends 36 percent of all goods to East North Central, and 34 percent to West South Central, which includes the states of Louisiana, Oklahoma, Texas, and Arkansas.

Table 10: California's Top Trading Regions by Rail, 2040

Region	Total		Inbound		Outbound	
	Tons (millions)	% of Total	Tons (millions)	% of Total	Tons (millions)	% of Total
East North Central	95.5	32%	51.8	32%	43.7	36%
West South Central	73.8	25%	32.4	20%	41.4	34%
West North Central	45.3	15%	36.4	22%	8.9	7%
Mountain	26.4	12%	20.0	12%	6.4	5%
East South Central	14.2	5%	6.1	4%	8.1	7%
Pacific	10.4	4%	6.1	4%	4.3	4%
South Atlantic	9.5	3%	3.9	2%	5.6	5%
Canada	6.5	2%	5.9	4%	0.6	< 1%
Middle Atlantic	4.1	1%	1.1	< 1%	3.0	3%
New England	0.9	< 1%	0.2	< 1%	0.6	< 1%
Mexico	0.1	< 1%	0.1	< 1%	0.0	0%
Total	**286.8**	**100%**	**164.1**	**100%**	**122.7**	**100%**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

For many regions, the top inbound/outbound commodity is expected to remain mixed freight in 2040, particularly the regions of East North Central, East South Central, Middle Atlantic, South Atlantic, New England, and West South Central. Cereal grains transported to California from the West North Central region are projected to comprise the highest amount of tonnage after mixed freight, with over 14.5 million tons. Coal from the Mountain region remains a significant California import with 4.5 million tons are expected to be shipped into the state in 2040, although this volume remains unchanged from 2013. Finally, basic chemicals and animal feed are two other important imports from the West North Central region, projected in excess of 5 million and 6 million tons, respectively. On the outbound side, California will ship amounts of other food stuffs and other agricultural products (2.6 million tons each) to East North Central, and high amounts of basic chemicals (1.3 million tons) and motorized vehicles (1 million tons) to the West South Central region. Overall, top inbound commodities in 2040 are expected to be 17 percent greater than outbound commodities, with over 107 million tons shipped outbound compared to 125 million tons shipped inbound.

Table 11 provides more detail on the breakdown of the top 5 regions per rail service type projected for 2040 between California and other trade regions throughout the United States, Canada, and Mexico. There is a clear mix of carload and intermodal traffic within each region depending on the direction of flow. The East North Central region has the highest percentages of intermodal traffic traveling both inbound and outbound California, comprising the vast majority of this activity. This finding emphasizes the dominance of California as the gateway for Asian trade with Chicago as North America's largest freight hub. Additionally, coal, coke, iron ore, and bulk grain cargo is shipped to California primarily from the Mountain and West North Central Regions and shipped from California to several U.S. regions, but the largest proportion goes to West South Central.

Table 11: Top 5 Regions by Service Type and Tonnage, 2040

Service Type	Outbound			Inbound		
	Region	Tons (millions)	% of Region Total	Region	Tons (millions)	% of Region Total
All Other Traffic	East North Central	3.8	9%	West North Central	14.9	41%
	West South Central	3.2	8%	Mountain	10.1	50%
	Mountain	2.8	44%	West South Central	9.8	30%
	Pacific	1.6	36%	Canada	5.7	96%
	East South Central	1.6	19%	Pacific	5.3	87%
Intermodal	East North Central	39.8	91%	East North Central	47.1	91%
	West South Central	37.1	89%	West South Central	21.8	67%
	West North Central	7.4	83%	West North Central	7.6	21%
	East South Central	6.4	79%	Mountain	3.4	17%
	South Atlantic	4.7	83%	East South Central	3.3	54%
Coal, coke, iron ore, and bulk grain	West South Central	0.5	1%	West North Central	13.3	36%
	West North Central	0.1	2%	Mountain	6.7	33%
	East South Central	0.1	1%	Pacific	0.3	4%
	Pacific	0.1	2%	West South Central	0.2	< 1%
	Mountain	0.1	1%	Canada	0.2	3%
Assembled	West South Central	0.8	2%	East North Central	1.8	3%

motor vehicles	Mountain	0.2	3%	West North Central	0.9	2%
	East North Central	0.2	0.5%	East South Central	0.8	12.9%
	West North Central	0.1	1.4%	West South Central	0.6	1.9%
	Pacific	0.1	2.3%	Mountain	0.1	0.4%

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Table 12 details the number of units for the top five regions for each service type. As in the prior table, the East North Central region has the highest share of its traffic traveling intermodally both inbound and outbound California, reaching upwards of 96 percent and 98 percent of all intermodal activity, respectively. However, four other regions – West South Central, West North Central, East South Central, and South Atlantic – all receive over 95 percent of rail traffic intermodally from California.

Table 12: Top 5 Commodities by Service Type and Units, 2040

Service Type	Outbound			Inbound		
	Region	Units (thousands)	% of Region Total	Region	Units (thousands)	% of Region Total
All Other Traffic	East North Central	49.8	2%	West North Central	159.5	22%
	West South Central	39.2	1%	West South Central	128.6	7%
	Mountain	34.8	11%	Mountain	114.0	25%
	East South Central	20.5	4%	Pacific	59.7	52%
	Pacific	18.9	9%	Canada	58.1	94%
Intermodal	East North Central	2,991.7	98%	East North Central	2,703.5	96%
	West South Central	2,951.1	97%	West South Central	1,617.2	91%
	West North Central	567.7	96%	West North Central	390.6	55%
	East South Central	515.8	95%	Mountain	257.6	56%
	South Atlantic	368.6	97%	East South Central	218.0	79%
Coal, coke, iron ore, and bulk grain	West South Central	5.3	< 1%	West North Central	120.7	17%
	West North Central	1.2	< 1%	Mountain	86.6	19%
	East South Central	1.1	< 1%	Pacific	2.6	2%
	Pacific	1.0	< 1%	West South Central	2.3	< 1%
	Mountain	0.7	< 1%	Canada	2.1	3%
Assembled motor	West South Central	39.5	1%	East North Central	78.3	3%
	Mountain	10.4	3%	West North Central	41.5	6%

vehicles	East North Central	9.7	< 1%	East South Central	34.5	13%
	West North Central	6.0	1%	West South Central	29.5	2%
	Pacific	4.6	2%	Mountain	3.1	< 1%

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Trade Regions within California

Using the same eight distinct regions of trade activity, Exhibit 14 shows the projections of outbound and inbound commodity volumes in 2040 for each of the eight California regions. For both inbound and outbound shipments, the Southern California region comprises the majority of traffic at 56 percent and 74 percent, respectively. In total, nearly 138 million tons of commodities are expected to travel outbound and over 179 million tons of goods are expected to travel inbound California in 2040.

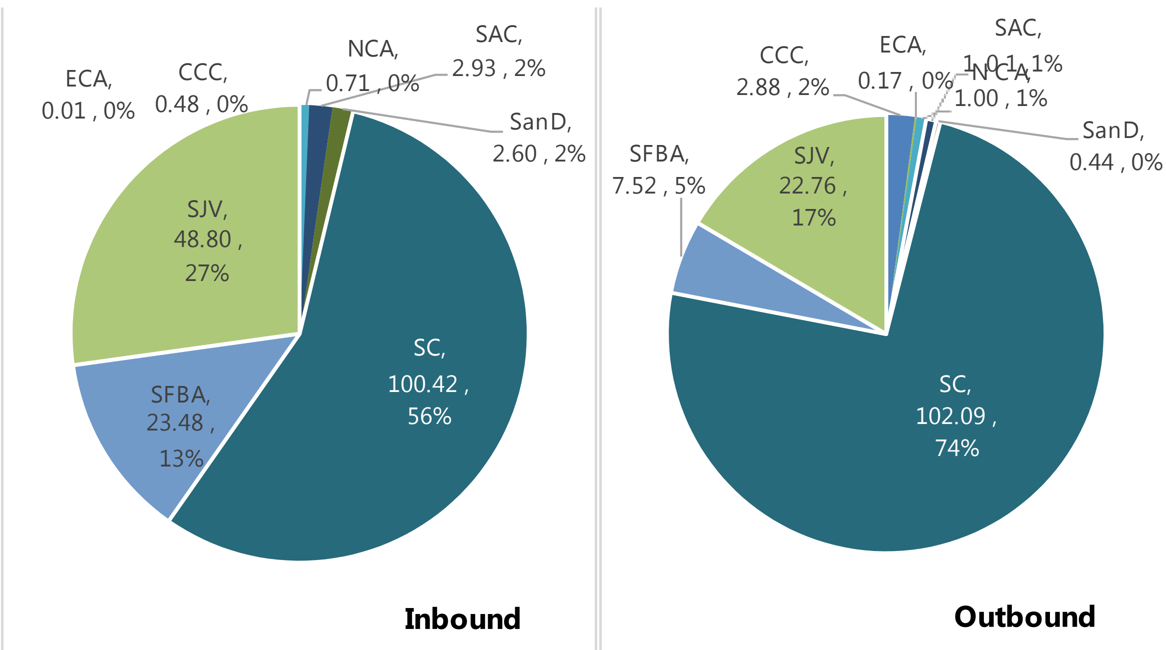


Exhibit 14: Trade Activity in California's 8 Regions, All Traffic, 2040

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Note: CCC = Central Coast California; ECA = Eastern California; NCA = Northern California; SAC = Sacramento; SanD = San Diego; SC = Southern California; SFBA = San Francisco Bay Area; SJV = Central Valley

Continuing recent trends, intra-state traffic is expected to account for only 5 percent of tonnage, or approximately 14.8 million tons. Table 13 shows a matrix of trade flows between each region, with some shipments originating and terminating in the same region. The Southern California region, particularly within Southern California itself, continues to be an important element of trade in California with respect to intrastate trade.

Table 13: Intra-State Commodity Flow (in thousands of tons) between California's 8 Regions, All Traffic, 2040

		Termination Region								
Origin Region		CCC	ECA	NCA	SAC	SanD	SOUTHERN CALIFORNIA	SFBA	SJV	TOTAL
	CCC	12.6	0.0	0.0	0.0	0.0	734.9	1,947.0	0.0	**2,694**
	ECA	0.0	0.0	0.0	0.0	0.0	14.0	0.0	127.7	**141**
	NCA	0.0	0.0	0.0	247.2	0.0	13.3	2.8	38.4	**308**
	SAC	0.0	0.0	0.0	3.2	0.0	48.2	68.0	10.9	**130**
	SanD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0**
	SC	42.4	3.2	50.9	609.6	548.3	5,176.7	745.1	945.5	**8,122**
	SFBA	0.0	0.0	102.4	57.1	60.4	507.9	36.6	317.4	**1,082**
	SJV	9.4	5.7	20.9	25.4	96.3	899.5	436.4	858.7	**2,352**
	TOTAL	**64.4**	**8.9**	**174.1**	**942.5**	**705.1**	**7,394.4**	**3,235.9**	**2,298.6**	**14,824**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Note: CCC = Central Coast California; ECA = Eastern California; NCA = Northern California; SAC = Sacramento; SanD = San Diego; SC = Southern California; SFBA = San Francisco Bay Area; SJV = Central Valley.

Exhibit 16 and Exhibit 17 show 2040 projections on a tonnage basis for county-level origination and termination in California. As was the case in 2013, the vast majority of tonnage is expected to flow in and out of Los Angeles County, 42 percent of inbound commodities and 71 percent of outbound commodities. The ports of Los Angeles and Long Beach drive much of this traffic as the top two largest ports in the county. After Los Angeles, San Bernardino and San Joaquin counties also have a significant amount of inbound and outbound commodity traffic, with between 12 percent and 13 percent arriving inbound and between 8 percent and 4 percent leaving outbound. In total, 49 percent of tonnage is expected to be domestic, 20 percent exported, and 31 percent imported, as shown in Exhibit 15.

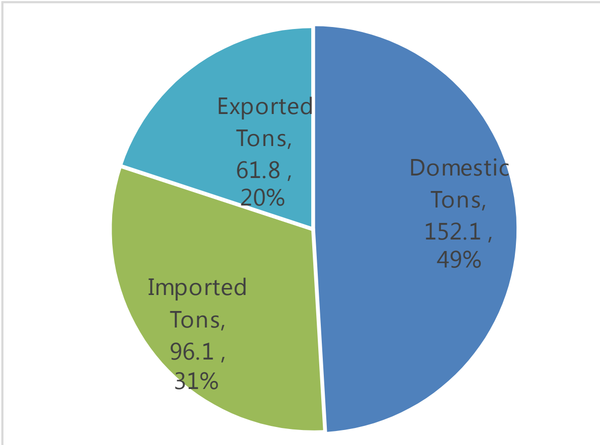


Exhibit 15: Tons by Origin in California, 2045

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

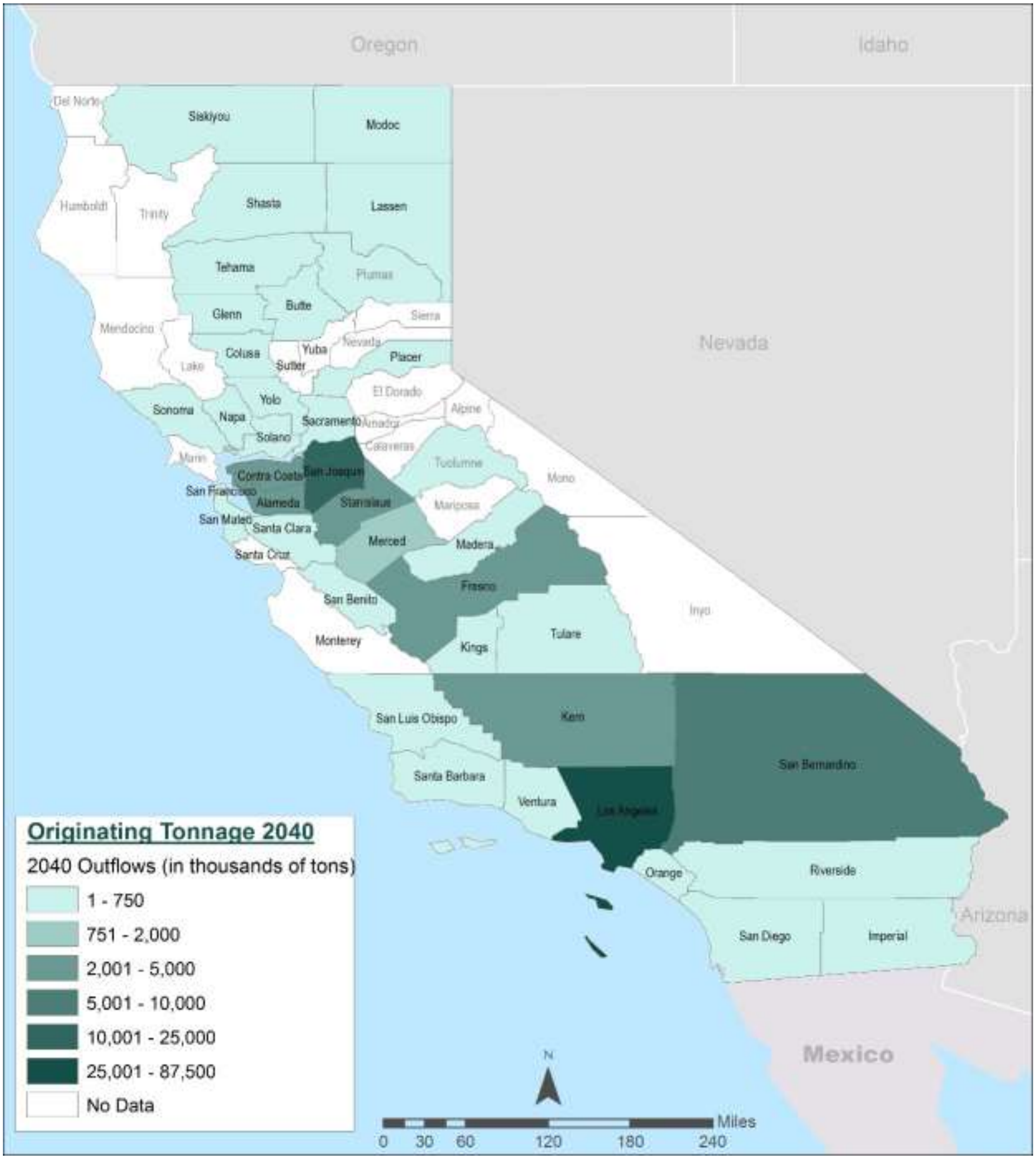


Exhibit 16: Originating Tonnage in California by County, 2040

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

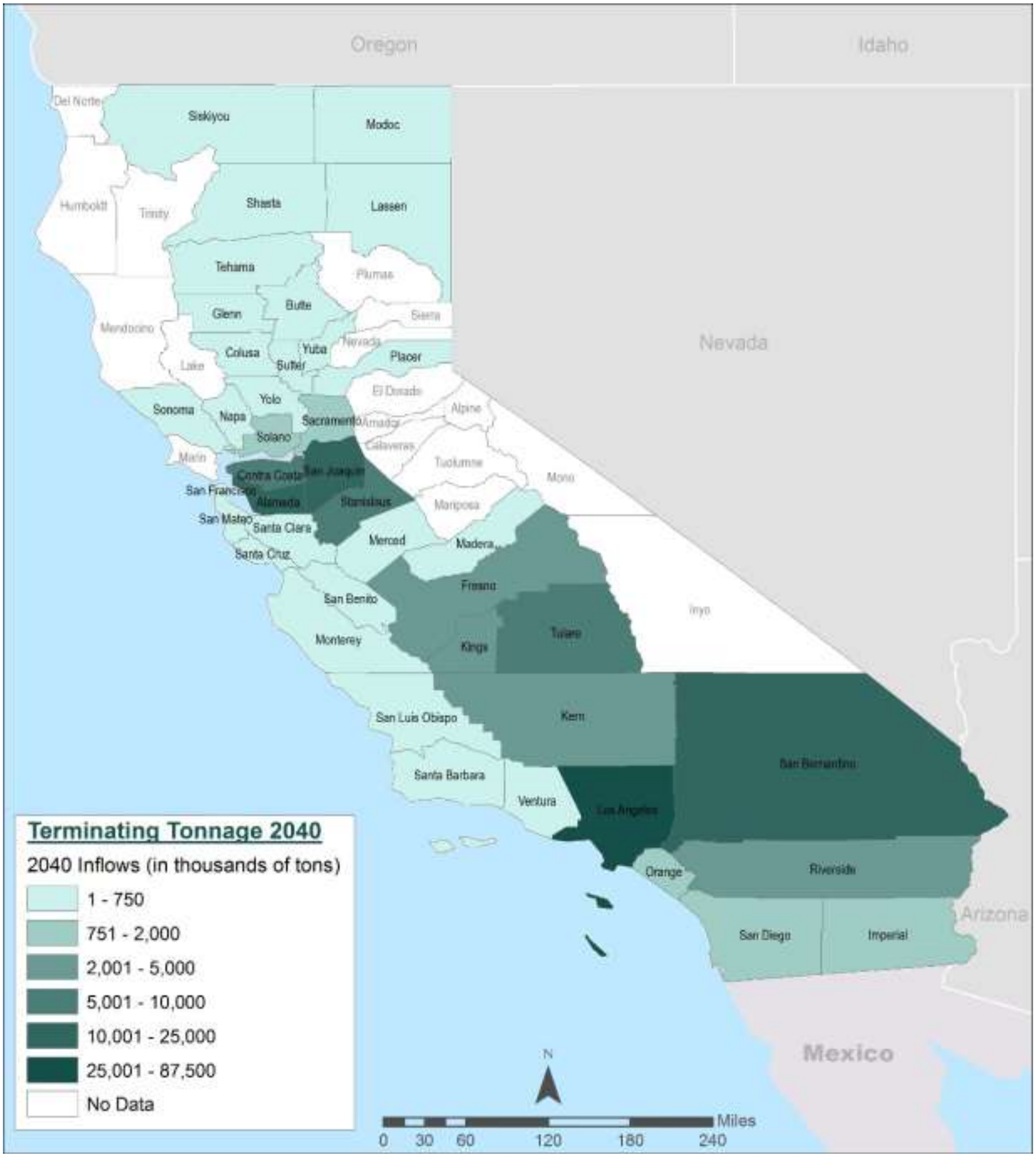
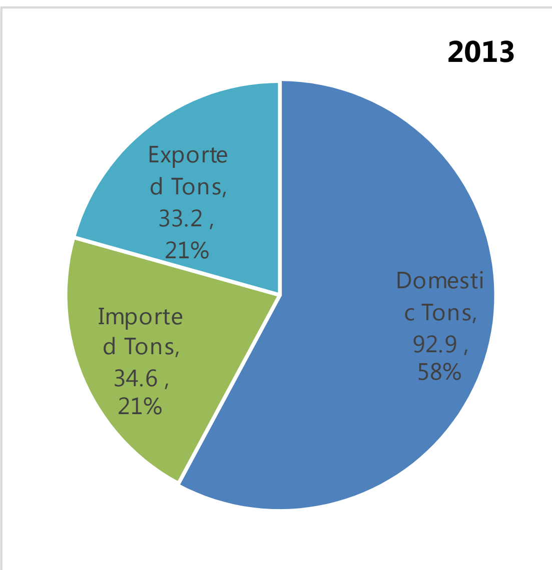


Exhibit 17: Terminating Tonnage in California by County, 2040

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Changes in Rail Freight Flows between 2013 and 2040

The forecasts for California's rail activity in 2040 suggest that some important changes in trade activity are expected to occur by 2040. First, tonnage is anticipated to grow substantially, from 161 million tons in 2013 to 310 million tons in 2040, a total growth of 93 percent. Exhibit 18 illustrates the breakdown of California's domestic, imported, and exported rail tonnage in 2013 and 2040. In 2013, 58 percent of tonnage originated within the United States, and exported tonnage and imported tonnage comprised 21 percent each of the remaining rail-based goods in California. By 2040, imported tonnage is expected to account for 31 percent of rail volume, at the loss of the domestic share, which declines from 58 to 49 percent of traffic. Exported tonnage is expected to decline slightly, from 21 to 20 percent. This shift implies the continued prominence of the California's ports as a principal gateway for imports from the Pacific Rim into the NAFTA region. The total growth of imported tons between 2013 and 2040 is 178 percent, and 87 percent for exported tons.



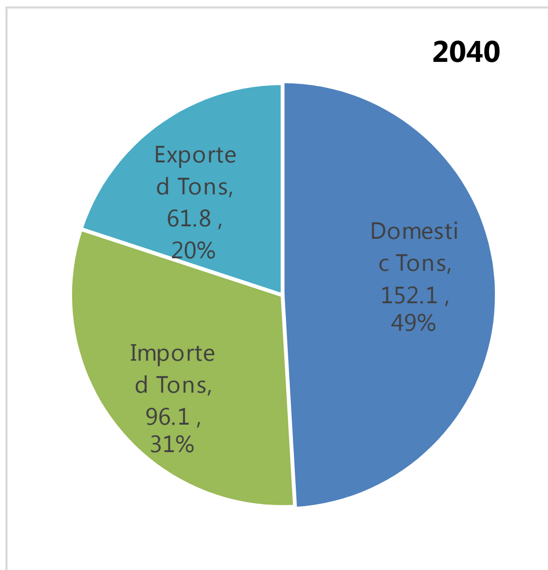


Exhibit 18: Origin of California Tonnage (in millions of tons), 2013 and 2040

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework (FAF) 3, data from Ports of Long Beach and Los Angeles

Despite the shift in commodity origin, the directional distribution is not expected to change substantially between 2013 and 2040, as shown in Exhibit 19. Inbound traffic to California comprises the largest category, increasing from 94 million tons in 2013 to 165 million in 2040, a total growth of 75 percent. The second highest proportion of goods travel outbound from

California to other regions, increasing from 51.4 million in 2013 to 123.0 million tons in 2040, a total growth of 139 percent. The sharp increase in this traffic is largely related to increased imports. Intrastate and through tonnage also increase between 2013 and 2040, with total growth of 39 percent and 67 percent, respectively. When measured in units, volume increases between 2013 and 2040 are even greater. Outbound traffic increases by 162 percent, from 3.2 million units to 8.3 million units, and inbound traffic by 93 percent, from 3.4 million units to 6.5 million units.

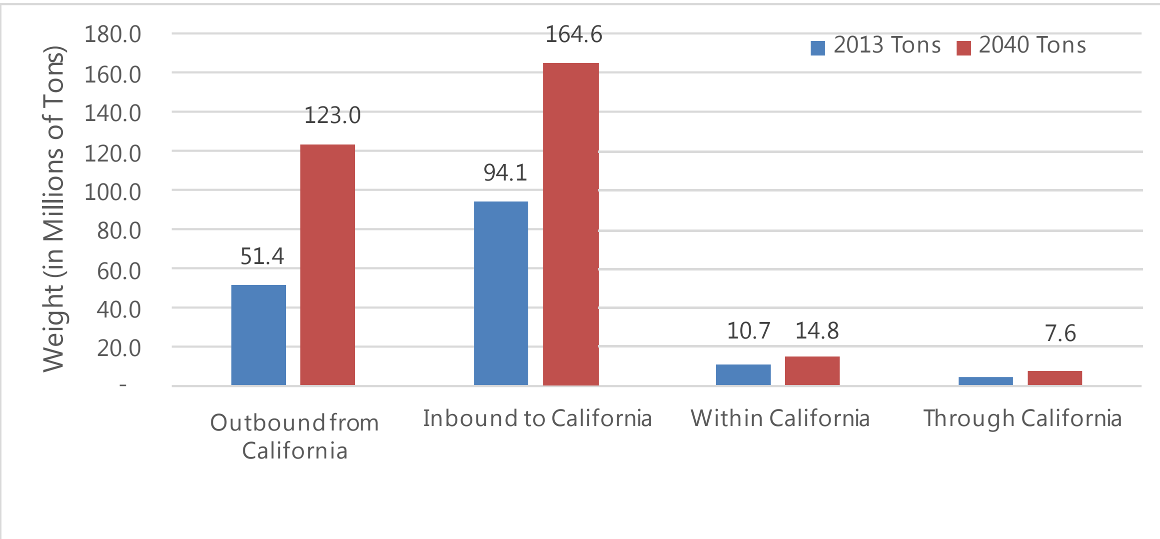


Exhibit 19: Directional Distribution of California Rail Tonnage

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework (FAF) 3, Ports of Long Beach and Los Angeles

A shift is also expected in the top rail commodities in California between 2013 and 2040, as shown in Table 14. The totals include tonnage transported in, out, within, and through California by rail (including imports and exports through California's ports). As noted in previous sections, mixed freight is the dominant product traveling via rail, and is expected to be an even more important product in 2040. Mixed freight – which contains products such as consumer goods, including packaged foods, electronics, office supplies, and durable goods, along with a broad range of intermediate components for manufacturing, such as auto parts – increases from 57 million in 2013 to over 141 million in 2040 at an annual growth rate of 3.4 percent. Cereal grains and basic chemicals maintain the second and third rankings, respectively. Cereal grains are expected to increase at an annual rate of 2.0 percent and basic chemicals at a rate of 1.5 percent. Another notable shift is the transport of motorized vehicles by rail in California, which are expected to increase by 83 percent from 2013 to 2040, or 4.2 million tons to 7.7 million tons, respectively. This growth reflects a combination of continued growth in imports of motor vehicles, as well as increased volumes flowing into California from North American production centers.

Table 14: Top 20 Commodities on California Rail, All Directions, 2013 and 2040

SCTG Code	SCTG Commodity Description	2013 Tons Ranking	2040 Tons Ranking	Total Tons (millions), 2013	Total Tons (millions), 2040	Total Growth 2013-2040
43	Mixed freight	1	1	57.0	141.1	148%
02	Cereal grains	2	2	13.8	23.7	72%
20	Basic chemicals	3	3	12.5	18.8	50%
07	Other foodstuffs	4	4	7.6	13.0	70%
04	Animal feed	5	5	6.0	11.1	84%
26	Wood prods.	6	12	5.4	5.6	5%
32	Base metals	7	10	5.3	6.1	16%
19	Coal and petroleum prods.	8	9	5.2	6.2	20%
15	Coal	9	15	4.6	4.6	< 1%
27	Newsprint/paper	10	7	4.4	6.5	48%
36	Motorized vehicles	11	6	4.2	7.7	83%
31	Nonmetal min. prods.	12	8	3.8	6.4	67%
24	Plastics/rubber	13	11	3.6	6.1	68%
12	Gravel	14	16	3.1	4.6	46%
08	Alcoholic beverages	15	20	2.6	4.2	59%
41	Waste/scrap	16	19	2.3	4.2	83%
03	Other ag prods.	17	17	2.1	4.6	120%
30	Textiles/leather	18	14	1.9	4.6	137%
37	Transport equip.	19	18	1.9	4.3	124%
06	Milled grain prods.	20	21	1.9	2.8	52%

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Another clear shift in rail trade is evident in California's intrastate shipping trends. Although cargo is not expected to originate in San Diego by 2040, high growth is expected in shipments from San Francisco to San Diego (308 percent between 2013 and 2040) and the Southern California to San Diego (229 percent). Additionally, shipments within the Central Coast California are expected to increase by 242 percent, while shipments from Northern California to San Francisco are also expected to increase by a similar amount.

Most origin-destination combinations are projected to either increase in tonnage or remain stable. However, in three instances volumes are expected to decline. Shipments between Northern California and the Central Valley are expected to decrease by 24 percent between 2013 and 2040. Similarly, shipments between Southern California and Eastern California are expected to decrease 25 percent. Finally, commodities moved by rail within San Francisco are expected to decrease by 22 percent total. In origin-destination combinations where no commodities were shipped by rail in 2013, goods movement by rail was not projected for 2040.

Understanding the share of tonnage among the primary trade regions throughout California helps illustrate changes in the role of these regions in California's economy. Table 15 presents the share of outbound tons from each of California's 8 regions, which includes both domestic outbound traffic by rail and exported tonnage at California ports. Notably, the Southern California region is expected to increase its proportion of outbound tonnage by rail, from 68 percent to 74 percent. This region also has the highest annual growth rate (3.3 percent) and total growth (142 percent). This trend suggests continued increases in imports through the San Pedro Bay ports, arriving by ship and transported throughout the United States by rail. The Central Valley is the second most significant region for outbound tonnage by rail. Though its share is expected to decline between 2013 and 2040, it nearly doubles in size over the same period, with an annual growth rate of 2.5 percent.

Table 15: Share of Outbound Tons from California's 8 Regions, 2013 and 2040

Region	2013 Tons (millions)	% of Total	2040 Tons (millions)	% of Total	CAGR (2013-2040)	Total Growth (2013-2040)
Central Coast California	2.0	3%	2.9	2%	1.4%	47%
Eastern California	0.1	< 1%	0.2	< 1%	1.5%	50%
Northern California	0.9	2%	1.0	< 1%	0.3%	10%
Sacramento	0.8	1%	1.0	< 1%	1.1%	33%
San Diego	0.3	< 1%	0.4	< 1%	1.8%	60%
Southern California	42.1	68%	102.1	74%	3.3%	142%
San Francisco Bay Area	4.1	7%	7.5	6%	2.3%	85%
Central Valley	11.8	19%	22.8	17%	2.5%	92%
Total	**62.0**	**100%**	**137.8**	**100%**	**3.0%**	**122%**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Next, Table 16 presents the share of inbound tons to each of California's 8 regions, which includes both domestic inbound traffic by rail and imported tonnage at California ports. As with outbound traffic, Southern California receives the majority of tonnage, but its share is expected to decrease from 63 percent in 2013 to 56 percent in 2040. However, it is still expected to receive 53 percent more tonnage over the course of this period, suggesting continued increases in exports at the Ports of Los Angeles and Long Beach, arriving from areas throughout the United States. Both the San Francisco Bay Area and Central Valley are expected to increase their share in inbound goods, and exhibit high annual growth rates and total growth overall.

Table 16: Share of Inbound Tons from California's Eight Regions, 2013 and 2040

Region	2013 Tons (millions)	% of Total	2040 Tons (millions)	% of Total	CAGR (2013-2040)	Total Growth (2013-2040)
Central Coast California	0.3	< 1%	0.5	< 1%	2.3%	84%
Eastern California	0.0	0%	0.0	0%	-0.1%	-3%
Northern California	0.4	< 1%	0.7	< 1%	2.1%	76%
Sacramento	1.9	2%	2.9	2%	1.6%	55%
San Diego	1.1	1%	2.6	1%	3.1%	129%
Southern California	65.6	63%	100.4	56%	1.6%	53%
San Francisco Bay Area	10.7	10%	23.5	13%	2.9%	119%
Central Valley	24.7	24%	48.8	27%	2.6%	98%
Total	**104.7**	**100%**	**179.4**	**100%**	**2.0%**	**71%**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Note: CAGR = Compound Annual Growth Rate

The final point of comparison between rail shipments in 2013 and 2040 pertains to regional trade partners, as presented in Table 17. Overall, the most substantial increases in California's rail activity – which includes domestic, import, and export traffic – are projected to occur with the West South Central region, which has an expected growth of 126 percent. West South Central and West North Central are expected to have the highest growth of outbound goods from California, 179 percent and 145 percent, respectively. On the other hand, the New England and Mexico regions are expected to have the highest growth of goods shipped inbound, 145 and 116 percent, respectively.

Table 17: Total Growth for Regional Trade Activity with California, All Traffic, 2013-2040

Region	Total Tons	Inbound Tons	Outbound Tons
Canada	63%	64%	59%
East North Central	113%	101%	131%
East South Central	90%	51%	138%
Mexico	115%	116%	98%
Middle Atlantic	101%	72%	114%
Mountain	67%	61%	89%
New England	100%	145%	87%
Pacific	53%	31%	101%
South Atlantic	80%	63%	94%
West North Central	73%	62%	145%
West South Central	126%	83%	179%
TOTAL	**97%**	**74%**	**139%**

Source: 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Train Volumes

Examining the impact of future train volume changes on the rail system is a key element of the 2018 California State Rail Plan. Changes from present train volumes will affect the performance of the system, its capital needs, and potential shifts in mode share between rail and other competing modes. Since train volume changes will not be uniform across the entire network, some segments may be subject to substantial volume gains, others could face stable demand, while others may face declines. This section of the report describes the methodology for generating the rail forecast and presents an analysis of its results.

In estimating train volumes using the data sources described in the Introduction, efforts were made to: (a) maximize use of available data, (b) keep sufficient geographical and rail market detail that can enable statewide rail planning, and (c) be consistent with economic forecasts and freight rail forecasts done as part of other studies. Also, it is important to recognize that the train volume estimates only include revenue freight trains. The methodology utilized for this analysis does not project repositioning moves consisting solely of empty equipment, light engines, or traffic associated with maintenance of way activities. Such traffic can contribute significant additional volumes, particularly around dense terminal areas.

Forecast Methodology

The 2018 California State Rail Plan (CSRP) builds on progress already accomplished in the 2013 CSRP. The basic methodology for deriving base year (2013) and future year (2040) train volumes for the 2018 CSRP, was to adjust train volumes estimated in the 2013 CSRP in accordance with changes in commodity flows as indicated by more recent historical and forecast data. The 2013 CSRP provided a strong foundation for network flows as it conducted a network assignment of 2007 and 2040 rail tonnage flows in order to derive estimates of daily average freight train volumes. The 2013 plan also validated the 2007 train volume estimates against freight train counts on selected rail segments from the state's Class I carriers – Burlington Northern Santa Fe (BNSF) and Union Pacific (UP) – and against train volumes as estimated from the San Pedro Bay Ports' QuickTrip – Train Builder model for Southern California rail segments.

Calculate Base Year Volumes

The 2013 base year train volumes were determined by calculating and applying tonnage growth factors, based on the 2013 Surface Transportation Board Carload Waybill Sample (CWS) and the 2013 CSRP, to the 2013 CSRP's base year train volumes.

Step 1 – Organize Base Year Waybill Observations into Rail Segments – First, the 2013 CWS observations were aggregated by service type (i.e. intermodal or non-intermodal) and origin/destination into a geographical set of rail tonnage flows. Based on the origins and destinations of those flows, the tonnages were associated with rail segments as indicated by the 2013 CSRP's network assignment.

Step 2 – Estimate Base Year Train Volumes – Next, the ratios of the current plan's base year tonnages (2013) to the previous plan's base year tonnages (2007) were calculated. Those ratios were then applied to the previous plan's base year train volumes (2007) to estimate the 2013 train volumes. Thirty-two adjustment factors were developed in this Plan for eight rail corridors (located in non-overlapping geographical areas) in the State and for two rail service types (intermodal and non-intermodal).

Forecast Growth

The FHWA Freight Analysis Framework FAF version 3.5 (FAF3) served as the basis for determining the rate at which California rail traffic, as indicated by the 2013 CWS, will grow over the forecast horizon. This process involved linking FAF3-derived commodity flow growth rates (which are at the geographic level of FAF3 zones) to 2013 CWS rail traffic volumes (which are at the rail station level but can be matched to counties). The spatial disconnect between the two databases necessitated disaggregating the FAF3 to the county level. Counties were chosen as the spatial scale of analysis because they allow enough geographic detail for network assignment while containing enough data for meaningful analyses. Overall, the process was structured in a series of seven steps, discussed in more detail below.

Step 1 – Identify Unique CWS Shipping Lanes – The first step identified unique origin-destination-commodity-mode (ODCM) combinations observed in the 2013 CWS. Origins and destinations were specified at the county level for rail traffic with endpoints within California. Observations with endpoints outside of California were specified at the state level. Because the 2013 CWS utilizes the Standard Transportation Commodity Codes (STCC) while the FAF3 uses the Standard Classification of Transported Goods (SCTG), commodity codes as given in the 2013 CWS were matched to their SCTG counterparts using a crosswalk before specifying ODCM. Modes, as specified in ODCM, correspond to intermodal and non-intermodal as indicated in the 2013 CWS.

Step 2 – Disaggregate the FAF3 – The FAF3 divides California's economic geography into five zones: Los Angeles combined statistical area, San Diego metropolitan statistical area, Sacramento combined statistical area, San Francisco combined statistical area, and Remainder of California. In this step, FAF3 zone-level commodity flows are disaggregated to county-level commodity flows.

Data from a TREDIS[6] database that was provided by Caltrans in the 2013 Rail Plan was used to disaggregate the FAF3 into county level commodity flows. TREDIS provided estimates of employment by industry, imported and exported goods and services, and the total dollar value of the production and consumption of commodities. It was the monetary value of production and consumption by commodity and county for the years 2013 and 2040 that served as the basis for disaggregating the FAF3.

The FAF disaggregation proceeded as follows:

1. First, the industry classifications in the TREDIS database were matched to their corresponding or equivalent Standard Classification of Transported Goods (SCTG) commodity classifications in order to estimate production and consumption dollars by county and by SCTG commodity for the base and forecast years.

2. The analysis then linked each FAF3 zone with the respective counties that comprise it. It further identified those counties with a record of a rail flow (either as an origin or a destination) in the 2013 CWS. In this manner, the counties with rail access were determined.

3. After that, the analysis created a production-side disaggregation matrix. Each cell in the matrix represents a specific California county's share of the production for a particular commodity relative to all other California counties with rail access within the FAF3 zone to which the county belongs. This value was calculated for each commodity-county combination.

4. A consumption-side disaggregation matrix was likewise created. Each cell of the matrix represents a specific California county's share of the consumption for a particular commodity relative to all other California counties with rail access within the FAF3 zone to which the county belongs. This value was calculated for each commodity-county combination.

5. Next, the analysis addressed rail flows with an endpoint outside California. FAF3 zones outside of California were not disaggregated. Production and consumption shares for these areas entered their respective matrices as 1 (i.e. no disaggregation).

[6] http://www.tredis.com/. Accessed January 20, 2016.

6. The full FAF3 database was then reduced to only freight flows with "Rail" or "Multiple Modes and Mail" (which contains intermodal rail flows) as the domestic mode for the years 2013 and 2040.

7. The reduced FAF3 database was then joined with the production- and consumption-side disaggregation matrices using the domestic origin and destination FAF zones, effectively disaggregating the FAF.

8. Lastly, in order to be able to later merge the disaggregated FAF3 with the CWS, flows from or to areas outside of California in the disaggregated FAF were aggregated to the State level.

Because the disaggregation factors were only used to allocate the commodity flows in the FAF3 based on the shares of rail-served commodities and counties in each FAF region, we determined that there was likely very little change in the distribution of this activity between the 2013 and 2018 plan years. As a result, the previously calculated factors were still valid.

Step 3 – Calculate Growth Rates and Market Shares – Using the disaggregated FAF, the analysis then calculated growth rates by trade type (i.e. international or domestic) for the change in rail traffic volumes between 2013 and 2040. Growth rates were calculated for each unique combination of origin, destination, commodity, and mode. Because of the possibility that some unique origin-destination-commodity-mode (ODCM) combinations observed in the CWS may not be present in the FAF, growth rates were also calculated for unique commodity-mode combinations and also by mode alone, as fallback values for growth rates.

Similarly, market shares for each unique ODCM combination were calculated using the base year flows. Market shares are the percentage of an ODCM's flow that is either domestic or international (imports and exports). Again, to account for observations in the CWS that are not present in FAF, unique commodity-mode and mode market shares were calculated as well.

Step 4 – Merge Datasets – The next step merged the FAF3-derived forecast parameters (e.g. market shares and growth rates) with the CWS data using the ODCM as a unique identifier.

Step 5 – Adjust Near-Port Growth Rates and Market Shares – In order to incorporate more detailed information for stations that are located on or near California's major ports (e.g. Los Angeles, Long Beach, and Oakland), the analysis adjusted the intermodal growth rates and market shares associated with those stations by identifying their Standard Point Location Code (SPLC). The current long-range port forecasts were acquired and used to calculate growth rates and market shares for 2013 to 2040. Then, using the QuikTrip Train Builder model, the projected number of annual lifts was converted to container volumes. The same version of the QuikTrip Train Builder model used in the Southern California Association of Governments Regional Transportation Plan was used in this analysis.

Step 6 – Estimate Forecast Year Flows – This step applied the FAF3-derived forecast parameters (e.g. market shares and growth rates) to the 2013 CWS data using the ODCM and SPLC as unique identifiers. The result was a forecast containing tonnage, number of units, and value for each extant origin, destination, carrier (route), and commodity combination.

Step 7 – Estimate Forecast Year Train Volumes – The last step estimated forecast year train volumes. Forecast year (2040) train volumes were estimated by first calculating the ratios of the current plan's forecast year tonnages (2040) to the previous plan's base year tonnages (2007). Those ratios are then applied to the 2007 train volumes by service type to estimate the 2018 CSRP's forecast year train volumes.

Adjustments to Train Volume Estimates in 2013 California State Rail Plan

Daily average train volumes are estimated in the 2018 California State Rail Plan (CSRP) by adjusting the daily average train volume estimates in the 2013 CSRP. The 2013 CSRP conducted a network assignment of 2007 and 2040 rail tonnage flow estimates and derived 2007 and 2040 daily average freight train volume estimates. The 2013 CSRP also validated the 2007 train volume estimates against freight train counts using data available from Class I railroads of BNSF and UP on selected rail segments in the State, and San Pedro Bay Ports' QuickTrip – Train Builder model based train volume estimates for Southern California's freight rail mainlines. A summary of the methodology for the train volume estimations in 2013 CSRP is as follows:

1. **FAF3 Growth Rates based Approach including Network Assignment.** The set of rail segments for which the base year (2007) rail network assigned train volumes based on Association of American Railroads' 2007 National Rail Freight Infrastructure Capacity and Investment Study matched reasonably well against the UP and BNSF train counts, the train volume forecasts were done using the FAF3 dataset in a step-by-step manner:

    a. **Identification of growth rates**. Annual tonnage growth rates between 2007-2020 and 2007-2040 were taken from FAF3 database, and applied to base year (2007) 2007 Surface Transportation Board's (STB) Confidential Carload Waybill sample's tonnage data for California.

    b. **Adjustment of growth rates**. Three types of adjustments: (1) overall commodity growth rates for California Waybill sample were adjusted to be consistent with more recent economic growth trajectories, using TREDIS data, (2) the total growth rate from or to a California FAF3 zone was redistributed to their constituting counties by use of county's share of total FAF3 zone production forecast for outflows and a county's share of total FAF3 zone consumption forecast for inflows, and (3) intermodal rail flows adjusted using published port forecasts.

c. **Train Volume Estimation and Network Assignment**. This involved converting annual tonnage data to daily train volumes, and estimation of train volumes over rail segments with the help of network assignment for the years 2020 and 2040, followed by routing corrections.

d. **Productivity related Adjustment to Train Volumes by Rail Segment**. The 2007 AAR National Capacity study suggested that railroads anticipate that train productivity will improve by at least 0.5 percent per year over the period from 2007 to 2035. Therefore, a similar productivity improvement was applied to train volume growth rates here as well.

2. **FAF3 Growth Rates based Approach NOT including Network Assignment.** For the set of rail segments for which the base year (2007) rail network assigned train volumes based on the AAR study did not closely match various sources of train counts, the train volume forecasts were still done using adjusted FAF3 growth rates, however, the future train volumes on rail segments were not estimated using the AAR study methodology for rail network assignment. Instead, the actual train counts over the rail segments observed from these various sources of data were increased to future year values using adjusted FAF3 tonnage growth rates aggregated over the rail market(s) to which the trains operating on the segments likely belong.

3. **San Pedro Bay Ports Train Volume Forecasts.** Freight rail forecasts for several of the rail segments in Southern California were developed in conjunction with planning efforts by the by San Pedro Bay Ports. These were adopted for 2013 CSRP in order to be consistent with regional and port planning efforts.

For the 2018 CSRP, thirty-two (32) adjustment factors were developed for eight rail corridors (located in non-overlapping geographical areas) in the State, for two rail service types (intermodal and carload) and for each of the years of 2013 and 2040. The factors represent ratios of the 2013 and 2040 rail tonnage flows by rail corridor and rail service type in this Plan to the 2007 tonnage flows by rail corridor and rail service type in the previous plan (the 2013 plan); where the tonnage flows of a particular rail corridor are specified in terms of railroad-origin-destination combinations.

Table 18 shows the location of rail corridors, rail segments in the rail corridors, railroad-origin-destination combinations of freight flow through the rail corridors and adjustment factors by rail service type for the rail corridors. The ratios show that there has been a decline in rail traffic between 2007 and 2013, the decline is higher in carload rail traffic than in intermodal rail traffic. Intermodal rail traffic is expected to grow faster than carload rail traffic. The highest growth ratio in terms of carload rail traffic is expected on rail segments between Sacramento and Barstow and rail segments south of Orange. The highest growth in intermodal rail traffic is expected on rail segments between Sacramento and Barstow and rail segments east of Sacramento.

Table 18: Adjustment Factors to 2013 California State Rail Plan Freight Train Volume Estimates by Rail Corridor and Rail Service Type, 2013 and 2040

Rail Corridor Location	Origin-Destination-Railroad Combinations of Freight Flows through Rail Corridor	Base Year Freight Train Volumes Adjustment Factor (2013 to 2007 ratio)		Forecast Year Freight Train Volumes Adjustment Factor (2040 to 2007 ratio)	
		CL	IM	CL	IM
Rail segments east of Oakland, north of San Jose, west of Sacramento and west of Stockton	Originating or terminating by any railroad in San Francisco Bay Area	0.75	0.70	1.23	2.26
Rail segments east of LA, north of Orange, south of Barstow and west of Colton	Originating or terminating by any railroad in Southern California	0.85	0.99	1.38	2.15
Rail segments between Sacramento and Barstow and Sacramento and Los Angeles	(a) Originating or terminating by BNSF in San Francisco Bay Area or Northern California and headed to or coming from anywhere except Pacific northwestern parts of U.S., (b) Originating or terminating by UP in San Francisco Bay Area or Northern California and headed to or coming from Southern California or southwestern and southeastern parts of U.S., (c) Originating or terminating by any railroad in Central Valley, (d) Originating or terminating by any railroad in Southern California and headed to or coming from Pacific northwestern parts of U.S., (e) Through CA.	1.00	1.02	1.62	2.68
Rail segments east of Sacramento	(a) Originating or terminating by UP in San Francisco Bay Area or Northern California and headed to or coming from none of the following: Pacific northwestern parts of U.S. or southwestern and southeastern parts of U.S. or Southern California; (b) Originating or terminating by UP in Central Valley or Southern California and headed to or coming from one of the following states: ID, MT or WY.	0.94	0.97	1.50	3.60
Rail segments north of Sacramento	(a) Originating or terminating by any railroad in San Francisco Bay Area or Central Valley or Southern California and headed to or coming from: Pacific northwestern parts of U.S.; (b) Originating or terminating by any railroad in Northern California; (c)	0.70	0.95	1.02	2.63

	Through CA.				
Rail segments east of Barstow	(a) Originating or terminating by BNSF in San Francisco Bay Area or Northern California or Central Valley or Southern California and headed to or coming from anywhere except Pacific northwestern parts of U.S.; (b) Originating or terminating by UP in San Francisco Bay Area or Northern California or Central Valley and headed to or coming from southwestern and southeastern parts of U.S.; (c) Originating or terminating by UP in Southern California and headed to or coming from all except Pacific northwestern parts of U.S. and southwestern and southeastern parts of U.S.; (d) Through CA.	0.72	1.03	1.25	2.11
Rail segments between San Jose and Los Angeles	Originating or terminating by any railroad in Central Coast	0.71	0.00	1.07	0.00
Rail segments south of Orange	Originating or terminating by any railroad in San Diego or Mexico	0.82	1.00	1.75	2.58

Source: 2013 California State Rail Plan, 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Key: CL = Carload, IM = Intermodal

Forecasted Train Volumes

Table 19 and Table 20 show the estimated 2013 and 2040 freight train volumes using the adjustment factors by rail segment in the State. A rail segment is a part of a rail corridor with start station, end station and railroad subdivision. The tables also show whether the tracks in the rail segment have a shared use arrangement with passenger rail services.

The Southern California Association of Governments (SCAG) has made periodic updates to its forecast train volumes to account for additional information from the region's ports. However, the last update occurred in 2011 as part of the Comprehensive Regional Goods Movement Plan.[7] Since train volumes as estimated by SCAG are actively being used for planning purposes in the southern California region, they are jointly presented with the train volumes as estimated in this analysis as a range. As the SCAG forecast volumes are generally higher than those produced in this analysis, they may be viewed as an upper bound on likely future train volumes. Table 19 contains the projected future year daily total freight train volumes by rail subdivision for segments not included in the 2016 SCAG Regional Transportation Plan (RTP). Segments covered in the SCAG RTP are shown in Table 20.

[7] Southern California Association of Governments. Comprehensive Regional Goods Movement Plan and Implementation Strategy: Regional Rail Simulation Update Summary Report, Appendix J. November 2011.

Table 19: Proposed Future Year Total Freight Trains per Day by Rail Segment, Southern California Association of Governments Regional Transportation Plan (2016)

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
Ventura	Burbank Downtown	Burbank-Bob Hope Airport	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	6	0	6	10	0	10	1.9%
Ventura	Burbank-Bob Hope Airport	Gemco Plant	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	6	0	6	10	0	10	1.9%
Ventura	Gemco Plant	Chatsworth	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	6	0	6	8	0	8	1.1%
Ventura	Chatsworth	Ventura	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	4	0	4	6	0	6	1.5%
Santa Barbara	Ventura	Goleta	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	4	0	4	6	0	6	1.5%
Coast	Goleta	Guadalupe	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: NONE	4	0	4	6	0	6	1.5%

				Out-of-State: CS-AMTRK							
Coast	Guadalupe	Callender	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	4	0	4	6	0	6	1.5%
Coast	Callender	San Luis Obispo	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Coast	San Luis Obispo	Salinas	UP	Intercity: CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Coast	Salinas	Gilroy	UP	Intercity: CD-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Coast	Gilroy	Tamien	UP	Intercity: CD-AMTRK Commuter: CAL-JPBX Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Coast	Tamien	San Jose	UP	Intercity: CD-AMTRK Commuter: CAL-JPBX Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Tracy	Martinez	Port Chicago	UP	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	0	0	0	0	0	0	0.0%
Martinez	Martinez	Richmond	BNSF, UP	Intercity: CC-AMTRK, SJ-AMTRK Commuter: NONE Out-of-State: CS-AMTRK, ZE-AMTRK	10	8	18	24	12	36	2.8%
Stockton	Port Chicago	Stockton	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	4	6	10	6	14	20	2.6%

Sacramento	El Pinal	Sacramento	UP	Intercity: HSR Commuter: NONE Out-of-State: NONE	14	24	38	20	60	80	2.8%
Fresno	Stockton	El Pinal	UP	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	20	24	44	30	60	90	2.7%
Fresno	El Pinal	Sacramento	UP	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	8	0	8	10	0	10	0.8%
Stockton	Stockton	Merced	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	14	14	28	20	34	54	2.5%
Fresno	Stockton	Merced	UP	Intercity: HSR Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
Stockton	Merced	Madera	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	14	14	28	20	34	54	2.5%
Fresno	Merced	Madera	UP	Intercity: HSR Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
Stockton	Madera	Fresno	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	14	14	28	20	34	54	2.5%
Fresno	Madera	Fresno	UP	Intercity: HSR Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
Stockton	Fresno	Bakersfield	BNSF	Intercity: SJ-AMTRK Commuter: NONE Out-of-State: NONE	14	16	30	20	38	58	2.5%
Valley	San Fernando Valley	Lancaster	UP	Intercity: NONE Commuter: MTL-SCRRA	8	0	8	10	0	10	0.8%

				Out-of-State: NONE							
Oakland	Niles	Stockton	UP	Intercity: NONE Commuter: ACE-SJRRC Out-of-State: NONE	2	2	4	2	6	8	4.2%
Valley	Burbank Downtown	San Fernando Valley	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	8	0	8	10	0	10	0.8%
Coast	San Jose	Santa Clara	UP	Intercity: CD-AMTRK, CC-AMTRK Commuter: CAL-JPBX, ACE-SJRRC Out-of-State: CS-AMTRK	8	0	8	12	0	12	1.5%
Coast	Santa Clara	Newark	UP	Intercity: CC-AMTRK Commuter: ACE-SJRRC Out-of-State: CS-AMTRK	8	0	8	12	0	12	1.5%
Niles	Niles	Oakland	UP	Intercity: CC-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	0	2	4	0	4	2.6%
Niles	Newark	Niles	UP	Intercity: CC-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	2	2	4	4	6	10	3.5%
Coast	Newark	Oakland	UP	Intercity: CC-AMTRK Commuter: ACE-SJRRC Out-of-State: CS-AMTRK	3	3	6	4	8	12	3.6%
Martinez	Emeryville	Oakland	BNSF, UP	Intercity: CC-AMTRK, SJ-AMTRK Commuter: NONE Out-of-State: CS-AMTRK	10	14	24	16	34	50	2.8%
Martinez	Richmond	Emeryville	BNSF, UP	Intercity: CC-AMTRK, SJ-AMTRK Commuter: NONE Out-of-State: CS-AMTRK,	10	14	24	16	34	50	2.8%

				ZE-AMTRK							
Martinez	Martinez	Sacramento	UP	Intercity: CC-AMTRK, SJ-AMTRK Commuter: NONE Out-of-State: CS-AMTRK, ZE-AMTRK	8	10	18	11	25	36	2.6%
Sacramento	Sacramento	Marysville	UP, BNSF	Intercity: NONE Commuter: NONE Out-of-State: CS-AMTRK	8	4	12	12	12	24	2.6%
Valley / Black Butte	Marysville	Klamath Falls, OR	UP	Intercity: NONE Commuter: NONE Out-of-State: CS-AMTRK	4	4	8	6	12	18	3.0%
Peninsula	Santa Clara	San Francisco	UP	Intercity: CD-AMTRK Commuter: CAL-JPBX Out-of-State: NONE	6	0	6	12	0	12	2.6%
Martinez	Sacramento	Roseville	UP	Intercity: CC-AMTRK Commuter: NONE Out-of-State: ZE-AMTRK	14	18	32	22	66	88	3.8%
Roseville	Roseville	Reno, NV	UP	Intercity: Commuter: NONE Out-of-State: ZE-AMTRK	0	18	18	0	66	66	4.9%
Valley	Los Angeles	Burbank Downtown	UP	Intercity: PSS-AMTRK, CD-AMTRK Commuter: MTL-SCRRA Out-of-State: CS-AMTRK	12	0	12	18	0	18	1.5%
River East Bank	Los Angeles	East Los Angeles	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	0	8	8	0	18	18	3.0%
Needles	Barstow	Yermo	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: XPW-AMTRK, SW-AMTRK	14	48	62	24	98	122	2.5%

Needles	Yermo	Needles	BNSF	Intercity: NONE Commuter: NONE Out-of-State: SW-AMTRK	12	42	54	18	86	104	2.5%
Cima	Yermo	Las Vegas, NV	UP	Intercity: NONE Commuter: NONE Out-of-State: XPW-AMTRK	4	8	12	6	14	20	1.9%
Orange	Fullerton	Orange	BNSF, UP	Intercity: PSS-AMTRK Commuter: MTL-SCRRA Out-of-State: NONE	6	0	6	12	0	12	2.6%
Orange	Orange	Irvine	BNSF, UP	Intercity: PSS-AMTRK Commuter: MTL-SCRRA Out-of-State: NONE	8	0	8	16	0	16	2.6%
Orange	Irvine	Laguna Niguel	BNSF	Intercity: PSS-AMTRK Commuter: MTL-SCRRA Out-of-State: NONE	8	0	8	16	0	16	2.6%
San Diego	Laguna Niguel	Oceanside	BNSF	Intercity: PSS-AMTRK Commuter: MTL-SCRRA Out-of-State: NONE	4	0	4	8	0	8	2.6%
San Diego	Oceanside	San Diego	BNSF	Intercity: PSS-AMTRK Commuter: CSTR-NCTD Out-of-State: NONE	6	0	6	12	0	12	2.6%
Fresno	Fresno	Bakersfield	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
BNSF Mojave	Barstow	Mojave	BNSF	Intercity: NONE Commuter: NONE Out-of-State: NONE	14	16	30	20	38	58	2.5%
UPRR Mojave	Mojave	Bakersfield	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	24	24	48	36	60	96	2.6%
Gateway	Keddie	Klamath Falls, Oregon	BNSF	Intercity: NONE Commuter: NONE	4	0	4	6	0	6	1.5%

				Out-of-State: NONE							
Canyon	Marysville	Keddie	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	18	0	18	28	0	28	1.6%
Canyon / Winnemucca	Keddie	Flanigan, Nevada	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	16	0	16	24	0	24	1.5%
UPRR Valley	Marysville	Roseville	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	16	0	16	24	0	24	1.5%
UPRR Mojave	Mojave	Lancaster	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
UPRR Mojave	Lancaster	Palmdale	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	12	10	22	18	22	40	2.2%
UPRR Mojave	Palmdale	Silverwood	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	14	0	14	20	0	20	1.3%
Stockton	Port Chicago	Richmond	BNSF	Intercity: NONE Commuter: NONE Out-of-State: NONE	4	6	10	6	14	20	2.6%
Tracy	Stockton	Port Chicago	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	0	0	0	0	0	0	0.0%
Olive	Atwood	Orange	BNSF	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	4	0	4	6	0	6	1.5%

Source: 2013 California State Rail Plan, 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Table 20: Proposed Future Year Total Freight Trains per Day by Rail Segment, Southern California Association of Governments Regional Transportation Plan (2016)

Subdivision	Segment From/To	Segment To/From	Operating Railroads	Passenger Rail Services That Share Tracks	Proposed Base Year Total Daily Freight Trains, 2013			Proposed Future Year Total Daily Freight Trains, 2040			Compound Annual Growth Rate (CAGR), 2013-2040
					CL	IM	Total	CL	IM	Total	
Alhambra	Los Angeles	El Monte	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	6	16	22	10 - 14	36	46 - 50	2.8 – 3.1%
Alhambra	El Monte	Bassett	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	6	16	22	10 - 14	36	46 - 50	2.8 – 3.1%
Alhambra	Bassett	Pomona	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	6	16	22	10 - 31	36 - 79	46 - 110	2.8 – 6.1%
Alhambra	Pomona	Montclair	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	8	16	24	12 - 29	35 - 36	48 - 64	2.6 – 3.7%
Los Angeles	Pomona	Montclair	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	2	16	18	4 - 8	35 - 36	40 - 43	3.0 – 3.3%
Alhambra	Montclair	W. Colton	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	10	16	26	13 - 14	12 - 36	50 - 63	2.5 – 3.1%
Alhambra	W. Colton	Colton	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	12	14	26	20 - 27	32	52 - 59	2.6 – 3.1%

Yuma	Colton	Palm Springs	UP	Intercity: COA-AMTRK Commuter: NONE Out-of-State: SL-AMTRK	16	26	42	26 - 35	56 - 60	82 - 95	2.5 – 3.1%
Yuma	Palm Springs	Indio	UP	Intercity: NONE Commuter: NONE Out-of-State: SL-AMTRK	16	26	42	26 - 35	56 - 60	82 - 95	2.5 – 3.1%
Los Angeles	East Los Angeles	Pomona	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	2	12	14	4 - 13	26 - 27	30 - 39	2.9 – 3.9%
Los Angeles	Montclair	Mira Loma	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	4	16	20	6 - 8	35 - 36	42 - 43	2.8 – 2.9%
Los Angeles	Mira Loma	W. Riverside	UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: NONE	4	16	20	6 - 14	35 - 36	42 - 49	2.8 – 3.4%
* River West Bank	Los Angeles	Hobart	NONE	Intercity: PSS-AMTRK, COA-AMTRK Commuter: MTL-SCRRA Out-of-State: SW-AMTRK	0	0	0	0	0	0	0.0%
San Bernardino	Hobart	Fullerton	BNSF	Intercity: PSS-AMTRK, COA-AMTRK Commuter: MTL-SCRRA Out-of-State: SW-AMTRK	4	28	32	6 – 15	62 – 66	68 - 80	2.8 – 3.5%
San Bernardino	Fullerton	Atwood	BNSF	Intercity: COA-AMTRK Commuter: MTL-SCRRA Out-of-State: SW-AMTRK	4	28	32	6 – 15	62 – 66	68 - 80	2.8 – 3.5%
San Bernardino	Atwood	W. Riverside	BNSF	Intercity: COA-AMTRK Commuter: MTL-SCRRA Out-of-State: SW-AMTRK	6	28	34	10 - 25	62 – 66	72 - 91	2.8 – 3.7%

San Bernardino	W. Riverside	Riverside	BNSF, UP	Intercity: COA-AMTRK Commuter: MTL-SCRRA Out-of-State: SW-AMTRK	12	42	54	20 – 24	92 – 101	112 - 125	2.7 – 3.2%
San Bernardino	Riverside	High Grove	BNSF, UP	Intercity: COA-AMTRK Commuter: MTL-SCRRA Out-of-State: SW-AMTRK	12	42	54	20 – 24	92 – 101	112 - 125	2.7 – 3.2%
San Bernardino	High Grove	Colton	BNSF, UP	Intercity: COA-AMTRK Commuter: MTL-SCRRA Out-of-State: SW-AMTRK	12	42	54	20 – 24	92 – 101	112 - 125	2.7 – 3.2%
San Bernardino	Colton	San Bernardino	BNSF, UP	Intercity: NONE Commuter: MTL-SCRRA Out-of-State: SW-AMTRK	12	32	44	20 - 26	70 - 71	90 - 97	2.7 – 3.0%
Cajon	San Bernardino	Keenbrook	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: SW-AMTRK	14	36	50	24 – 90	77 – 78	102 - 167	2.7 - 4.6%
Cajon	Keenbrook	Silverwood	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: SW-AMTRK	14	36	50	24 – 55	77 – 78	102 - 132	2.7 - 3.7%
Cajon	Silverwood	Victorville	BNSF, UP	Intercity: NONE Commuter: NONE Out-of-State: SW-AMTRK	18	38	56	28 - 50	82	110 - 132	2.5 – 3.2%
Mojave	Keenbrook	Silverwood	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	14	4	18	19 - 24	5 - 10	25 - 34	1.2 - 2.4%
Alameda Corridor	Ports	Redondo Jct	UP, BNSF	Intercity: NONE Commuter: NONE	4	30	34	0 – 6	42 – 66	42 - 72	0.8 – 2.8%

				Out-of-State: NONE							
Alameda Corridor	Redondo Jct	East Los Angeles	UP, BNSF	Intercity: NONE Commuter: NONE Out-of-State: NONE	0	16	16	0	25 - 36	25 - 36	1.7 – 3.0%
River East Bank	East Los Angeles	LATC	UP	Intercity: NONE Commuter: NONE Out-of-State: NONE	0	8	8	0	12 - 18	12 - 18	1.5 – 3.0%
San Bernardino	Redondo Jct.	Hobart	BNSF	Intercity: NONE Commuter: NONE Out-of-State: NONE	4	14	18	0 - 6	17 - 32	17 - 38	0 – 2.8%

Source: 2013 California State Rail Plan, 2013 Surface Transportation Board's (STB) Confidential Carload Waybill Sample, Freight Analysis Framework 3, Ports of Long Beach and Los Angeles

Note: Segments marked with an asterisk (*) denote segments with consistent volumes and growth rates as derived by this analysis and the 2016 Southern California Association of Governments Regional Transportation Plan.

Key: RR = Railroad, CL = Carload, IM = Intermodal, TOT = Total, CAGR = Compound Annualized Growth Rate

Freight Rail Services: BNSF – Burlington Northern Santa Fe Railway, UP – Union Pacific Railroad

Intercity Rail Services: PS-AMTRK – Pacific Surfliner – Amtrak, CC-AMTRK – Capitol Corridor – Amtrak, SJ-AMTRK – San Joaquin – Amtrak, COA-AMTRK – Coachella Valley – Amtrak, CD-AMTRK – Coast Daylight – Amtrak, HSR – California High Speed Rail

Commuter Rail Services: ACE – Altamont Commuter Express - San Joaquin Regional Rail Commission, CAL-JPBX – Caltrain - Peninsula Corridor Joint Powers Board, MTL-SCRRA – Metrolink - Southern California Regional Rail Authority, CSTR-NCTD – Coaster - North County Transit District

Out-of-State Rail Services: CS-AMTRK – Coast Starlight – Amtrak, ZE-AMTRK – Zephyr – Amtrak, SL – Sunset Limited – Amtrak, SW – Southwest Chief – Amtrak, XPW – XpressWest - Amtrak

Appendix A.5 California Rail Funding Accounts

State Funding Accounts - Automatic Grade Crossing Warning Device Maintenance Fund

Table A.18 shows claims and claims paid under the Automatic Grade Crossing Warning Device Maintenance Fund. Claims are made by railroads to collect funding for the share of maintenance costs for automatic warning devices (typically 50 percent) owed by local roadway authorities (city or county). Claims paid reflect the actual amount paid by Caltrans for the maintenance of the automatic warning devices. Crossings refer to highway-rail crossings.

Table A.18: Grade Crossing Warning Device Maintenance Fund Claims and Budgets[9]

Fiscal Year	Number of Crossings	Total Claims (Millions of Dollars)	Total Paid (Millions of Dollars)
2005-2006	2,797	$4.09	$1.0
2006-2007	2,788	$3.90	$1.0
2007-2008	2,754	$3.85	$2.0
2008-2009	2,702	$3.81	$2.0
2009-2010	2,710	$3.83	$2.0
2010-2011	2,690	$3.80	$2.0
2011-2012	2,667	$3.78	$2.0
2012-2013	2,655	$3.76	$2.0
2013-2014	2,662	$3.77	$2.0

9 CPUC, Grade Crossing Maintenance Fund Program, February 2016.

Appendix A.6
Network Integration Strategic Service Planning (NISSP) Analysis Documentation

1.0 Introduction

This technical memorandum describes the process and outcomes of the Network Integration and Strategic Services Planning (NISSP) effort undertaken as part of the California State Rail Plan (Rail Plan). The network integration planning process was conceived by CalSTA in two phases:

1. **Statewide Market Assessment & Rail Infrastructure Review:** The first phase of effort was coordinated by CalSTA to undertake an evaluation of the market capture potential of an interconnected statewide passenger rail network using High Speed Rail modeling resources. This phase also included a review of statewide infrastructure constraints and network opportunities, including definition of boundary ”visions” for analysis and refinement. This analysis was undertaken prior to, and outside of the scope of the Rail Plan to provide inputs for the technical tasks that are part of the Rail Plan scope. Details of this analysis is included in separate documents.
2. **California State Rail Plan – Network Service Refinement and Statewide Passenger Rail Vision:** Refinement of Phase 1 boundary scenarios was undertaken by Caltrans during development of the Rail Plan, which responds to state requirements (GC Section 14036) for Caltrans to plan for a “comprehensive and integrated statewide passenger rail system, including High-Speed Rail, conventional intercity and commuter rail, and connections to urban rail systems.” This planning process included outreach to statewide passenger rail stakeholders to review and refine vision scenarios into a single long-term vision for the passenger rail network.

The overarching goal of the network integration planning process is to plan for a statewide passenger rail system that maximizes the performance potential of intercity passenger rail as a time- and cost-competitive travel option for meeting the State’s transportation needs and goals. This methodology is responsive to the following specific concerns / requests made by Caltrans DMRT and CalSTA:

- Current ridership forecasting models utilized for intercity rail forecasts are calibrated to current modes of operation and may underestimate rail demand for a system which delivers better on-time performance (OTP), provides better connectivity, and which provides more frequent service than generally exists today
- Current nominal Operations & Maintenance (O&M) cost factors per train mile or per train hour for intercity service may overstate future year costs and/or bias measures of

effectiveness when intercity services are better integrated into the Statewide high-speed rail and urban transit networks

- Detailed analysis of infrastructure requirements developed by identification of conflict points along existing infrastructure using specific trial operating plans may be less robust than evaluating capacities, service mixes and throughputs on a corridor and corridor sub-segment level

Institutional roles and responsibilities and recommendations on governance as part of an integrated network was not included within the scope of the network integration planning process and the State Rail Plan does not explicitly prescribe governance roles. Network integration planning and the California State Rail Plan are intended to provide a framework for prioritizing state investment in the passenger rail network and to guide incremental planning and investment decisions in phases so as not to preclude future investments needed to achieve the long-range vision. Decisions about governance should be informed by and based on an understanding of the systemwide goals and services to be operated.

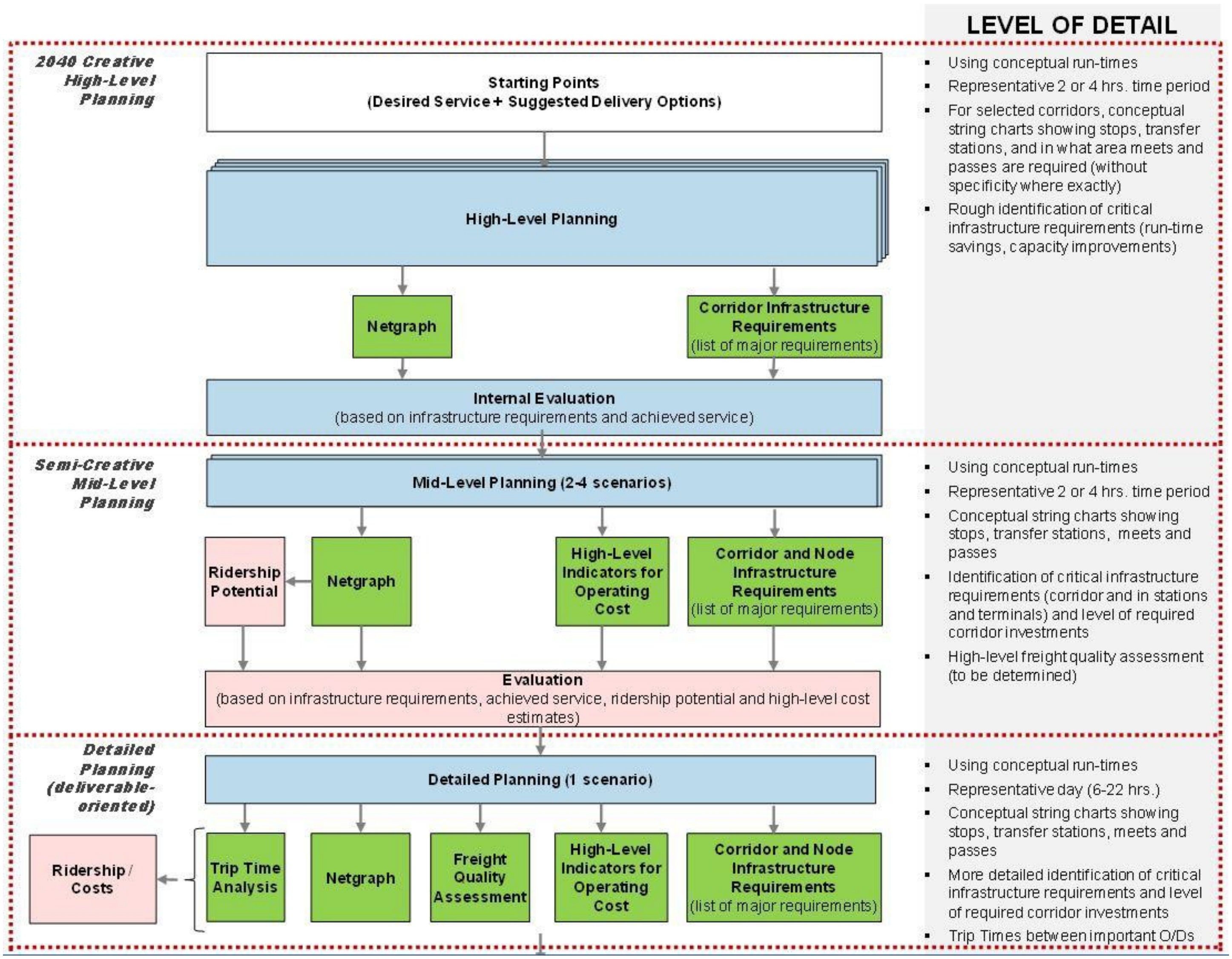
2.0 Process and Procedure

The network integration strategic planning process in the State Rail Plan itself was generally divided into three phases of activity:

1. Technical Collaboration
2. Service Plan Refinement
3. Final Service Plan Refinements and Vision

The following block diagram schematically identifies principal procedures accomplished in each phase. These three work periods are identified as “2040 Creative High-Level Planning”, Semi-Creative Mid-Level Planning” and “Detailed Planning (deliverable –oriented)”, respectively. These phases are described in more detail below.

Exhibit 1: Major Phases of Activity during Network Integration and Strategic Services Planning



1. Technical Collaboration

Network Integration Phase 1 Boundary Visions

The Boundary Visions of Phase 1 are not scenarios for the State Rail Plan, the Boundary Visions only describe service goals and are used to define scenarios for the long-term State Rail Plan Vision. [4]

The Boundary Visions define theoretic boundary conditions. The Boundary Visions are based on California's policy objective of creating an integrated network that uses HSR Phase 1, and they describe service visions that would result from the not-yet-defined policy goal of achieving high/low coverage and quality.

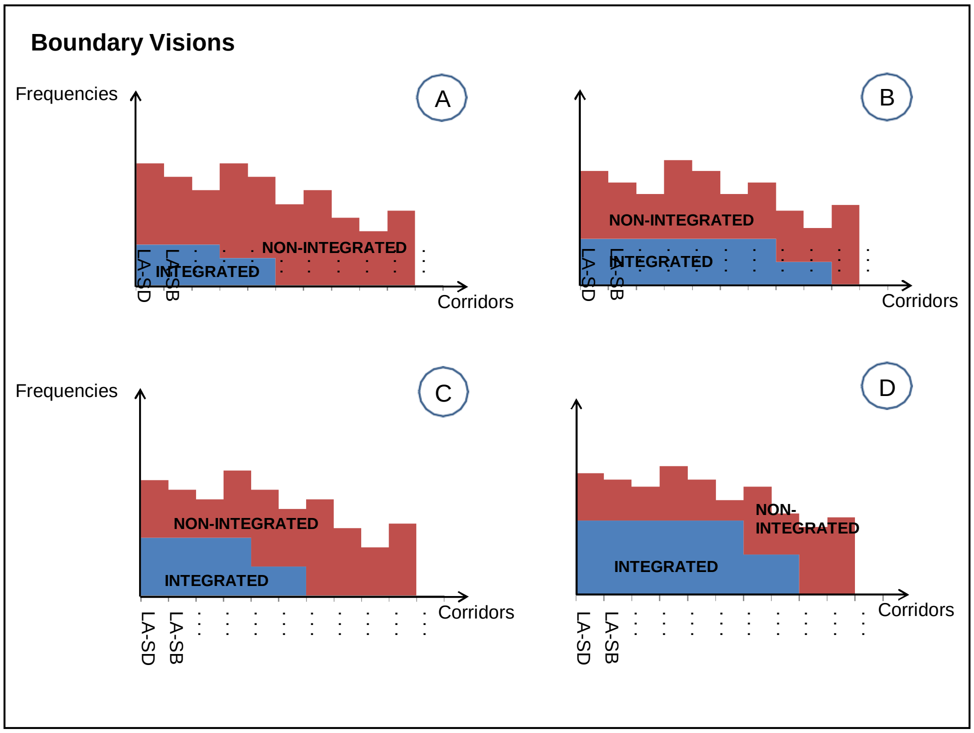
The boundary visions include only services of statewide relevance. Statewide relevance has a different meaning, depending on the desired coverage and quality as shown in the diagram on the following page.

The Boundary Visions describe solely public transportation service (the "desired service" or "product") and do not define operations or infrastructure (the "delivery"). Operations and infrastructure are considered only implicitly as existing run-times and conservative service

[4] A vision being a document defining desired service, a scenario being a starting point for analysis consisting of (1) desired service, (2) a specific idea how to deliver the desired service.

levels are used for Visions A and C, and therefore these should be realistic. Visions B and D, however, require market-competitive run-times and frequent service and therefore are realistic to the extent that credible future funding levels of sufficient magnitude to support the infrastructure development program are foreseeable.

Exhibit 2: Network Integration Boundary Visions – Service Quality vs. Coverage



Draft Vision Statement

The CSRP's draft vision statement, will be informed by the NISSP Phase 1 work and will describe the service vision and policy goals that have been used for Phase 1:

- Policy objective of creating an integrated public transportation network and solving the associated soft issues to overcome service fragmentation, including governance issues, ticketing and funding.

- Creation of a network which includes services and corridors which are so designated as serving a statewide need for public transport with to-be-determined quality and coverage parameters.[5]
- A network based on pulsed frequencies providing fast direct connections between major centers and by-design transfers to provide high-quality connectivity to and between smaller places throughout the state.

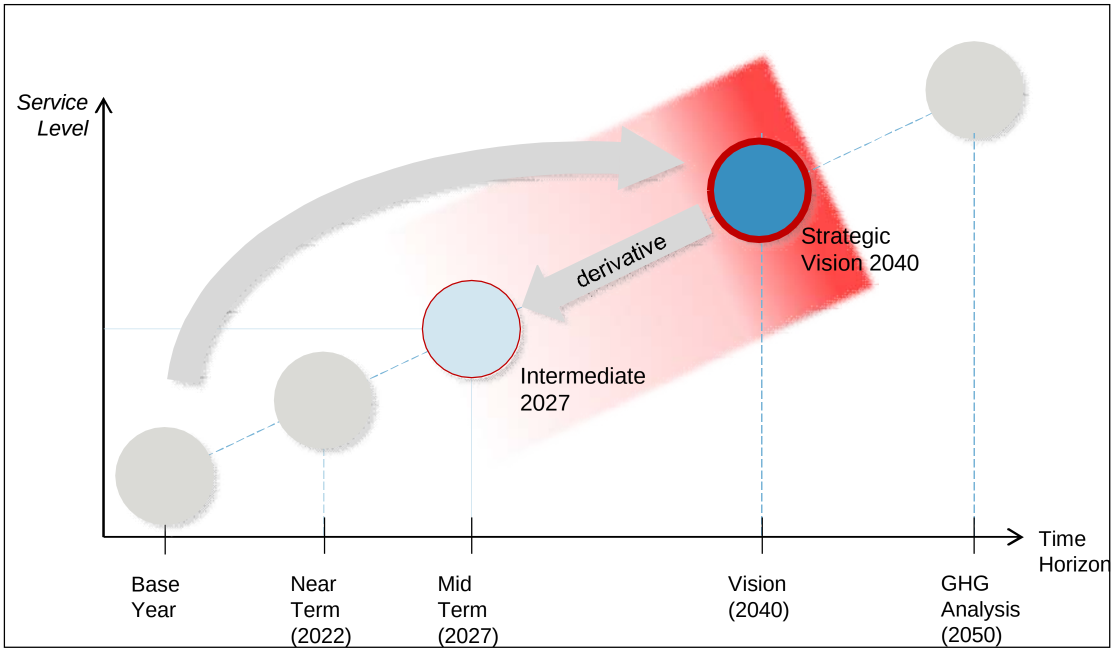
The Vision includes all services of statewide relevance, including high-speed rail, conventional rail and bus, which makes the State Rail Plan essentially a Statewide public transportation plan.

Scope of Network Integration – Phasing of the Network Vision

Based upon early collaboration between CalSTA and Caltrans in September 2015, it was confirmed that the 5-Year (Near Term) plan will essentially provide an update to current infrastructure investment and services expansion plans in process, updated to reflect current conditions. It was also determined that the focus of Network Integration will be the 2040 Vision plan (25-Year horizon) and that the 10-Year Intermediate plan will be derived from the 2040 Vision plan. (With the 2050 horizon reserved for Greenhouse Gas analysis.)

[5] "Public Transport" as used in the context of the State Rail Plan refers to all forms of transportation which are available for purchase by or provided to the general public including but not limited to rail services, intercity bus, mass transit (bus and rail), taxis and "Technology Enabled Transportation Services" for which a payment is collected (such as "Uber" or "Lyft"). Excluded from the Public Transport category are privately operated vehicles (whether driven solo or as shared-ride), goods movement conveyance, and commercial vehicle operations not open to the general public.

Exhibit 3: Network Integration Phasing

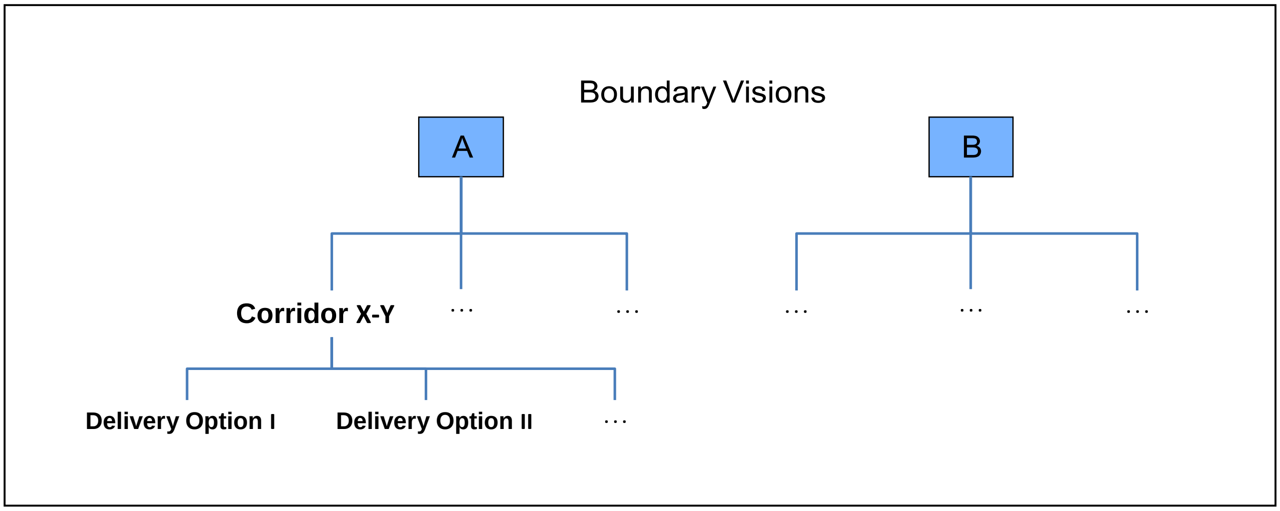


Technical Collaboration Workshops

The Boundary Service Visions from NISSP Phase 1 were used as an input to define a set of scenarios for further analysis. These scenarios have to both define desired service (e.g., become one of the service visions or an adaption of the service visions) as well as to provide guidance on how to pursue the desired service (“delivery options”).

During the Phase II Scenario Development Workshop the team discussed and defined potential options to deliver the envisioned service levels of each Boundary Vision, corridor-by-corridor, as shown in the diagram below:

Exhibit 4: Boundary Vision Development – Corridor Service Delivery Options



For most corridors only a few types of delivery options are available:

- Existing Highway Corridor (with Intercity Bus) with or without Managed Lanes;
- Shared Existing Freight Rail Corridor with Access Agreements (with potential revisions to access agreements and performance metrics);
- Shared Existing Passenger Rail Corridor Existing Rail Corridor primarily for passenger operation (acquired corridor or revitalized abandoned corridor);
- New Conventional Passenger Rail Corridor (new alignment);
- Enhanced Existing or New Urban Transit Corridor (bus/BRT or rail);
- New High-Speed Rail Line;

Or;

- Revisit Service Goal (if no delivery option available or reasonable).

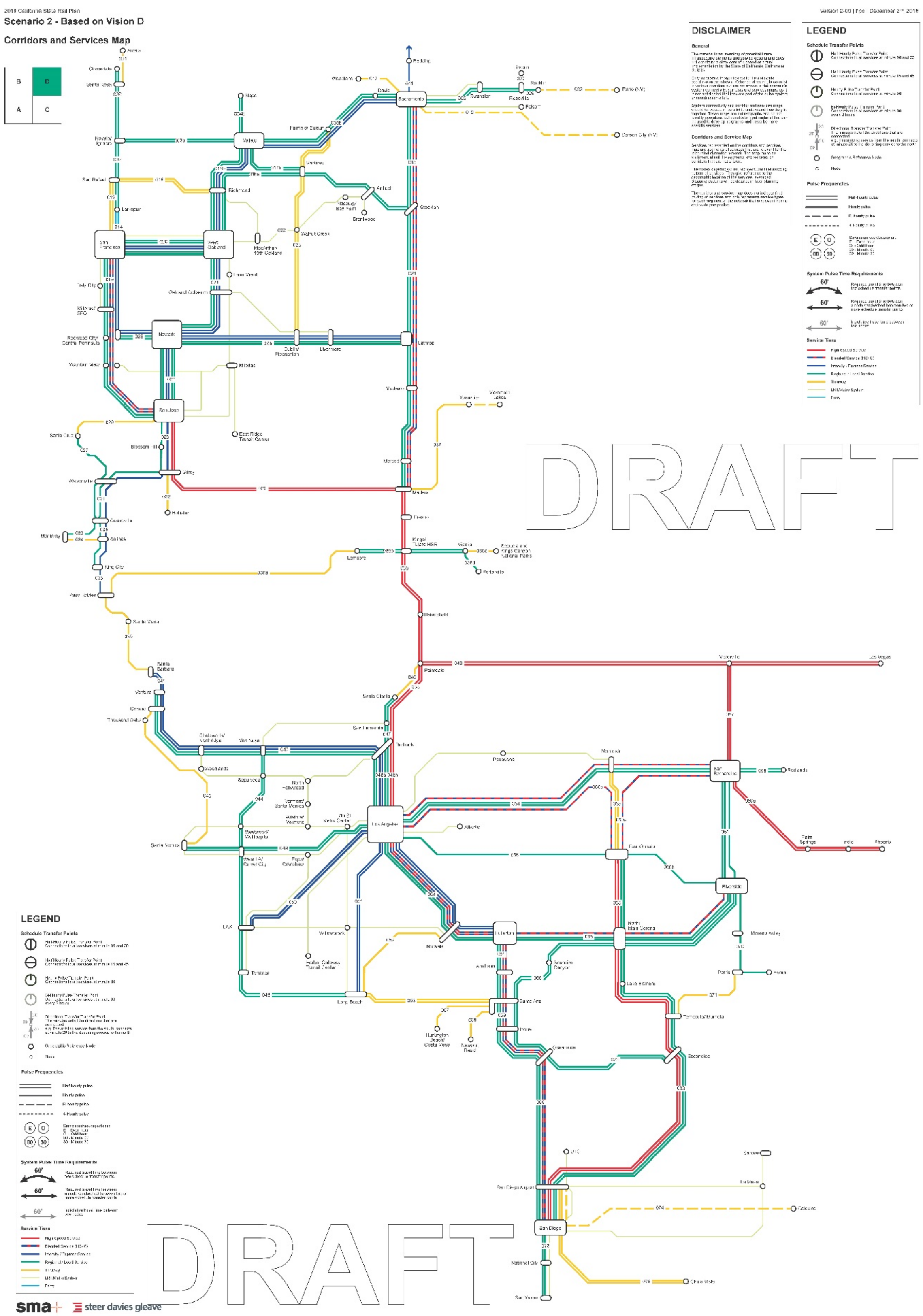
For critical transfers/connections the team considered delivery options at the station level:

- Existing Station;
- Improved Station;
- New or Relocated Station;

Or;

- Revisit Service Goal (if no delivery option available or reasonable).

Exhibit 5: Boundary Vision Development – Example Service Delivery Option Outputs



The perspective of the freight railroads was respected when describing delivery options and their needs reflected in the suggested delivery option.

Using the Boundary Visions and Delivery Options, starting points for the SRP scenarios are specified (Initial Scenario Definition). These starting points include a clear service goal and suggested delivery methods corridor-by-corridor, for instance:

- *Achieve hourly intercity service with a 60-minute run-time between Sacramento and Stockton, making connections at Sacramento to Reno, Redding and Fairfield/Vacaville and in Stockton to Livermore and Tracy. Use the existing rail corridor assuming feasibility of the required speed improvements, and a new-type access agreement with the host railroad.*

Note: In all cases planning for expansion of passenger services on freight corridors included consideration of replacing lost capacity needed to support projected increases in freight traffic, to the extent that such capacity is available.

Guided by the Initial Scenario Definitions the analysis engaged in a creative, high-level planning exercise, dropping clearly unattractive scenarios based on an internal evaluation process:

- Is the service outcome attractive?
- Would we need clearly unrealistic design requirements to get scenario to work?

An objective of the Technical Collaboration process was to determine a range of credible service frequencies and delivery options along principal corridors between key nodes based upon the previous Market Analysis, competing peak and off-peak highway times and potential rail journey times.

Three scenarios representing conservative, moderate, and aggressive network options informed by the Phase 1 boundary Visions were presented to state rail providers at a series of workshop sessions to solicit feedback in December.

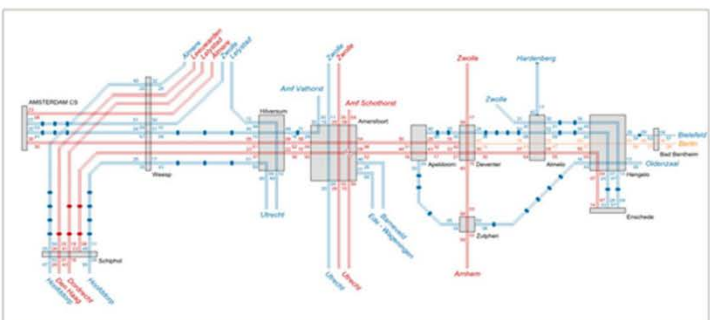
The results of these evaluations were considered by Caltrans in the Service Plan Refinement phase to develop a single scenario recommended for inclusion as the State Rail Plan Vision.

2. Service Plan Refinement

Subsequent to the Technical Collaboration Workshops, Viriato software was utilized to develop “Netgraphs” depicting the service scenarios. Viriato was also used to develop “String Line” charts which can be used to identify key operational constraints and inefficiencies. This information was considered along with a mainline “Level of Service” to develop an Infrastructure Requirements Assessment.

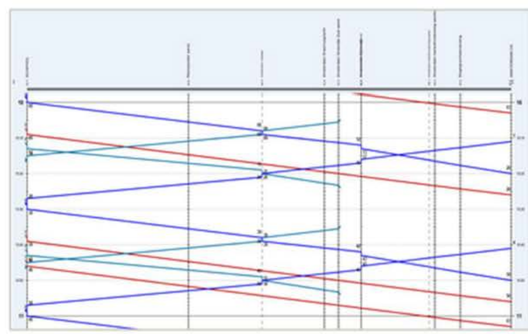
Exhibit 5: Example Viriato Service Planning Software Outputs

Netgraph



- Provides a geographic representation of a timetable
- Allows for observation of connection possibilities at interchange nodes

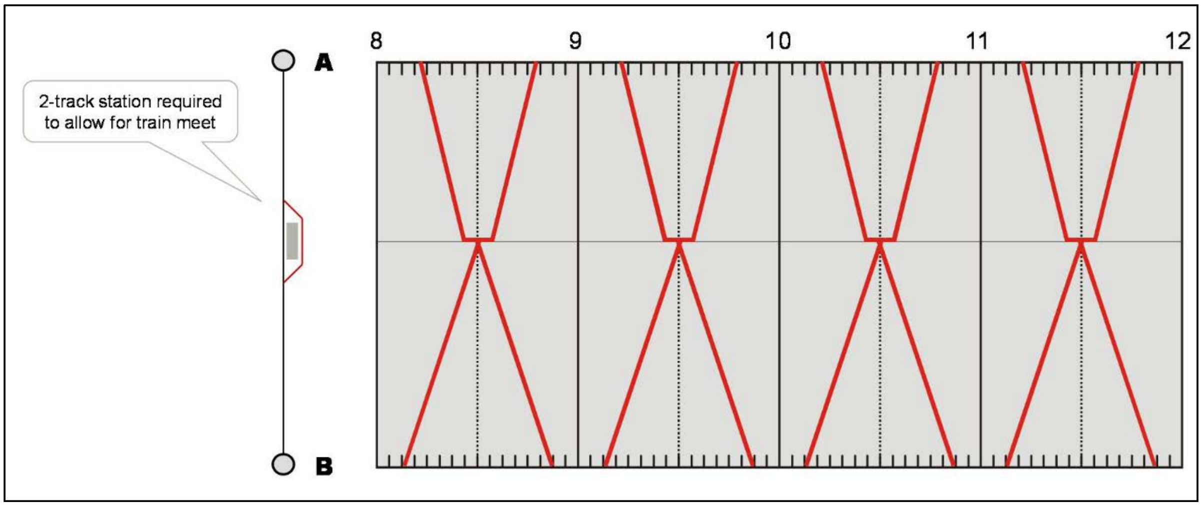
String line charts



- Provides a visual representation of interval-based service patterns along a given line
- Allows for observation of operational constraints and inefficiencies

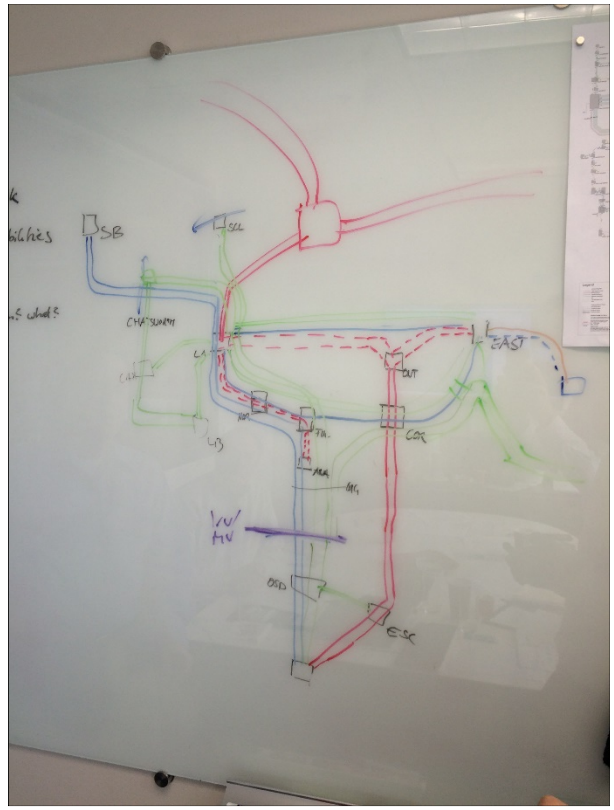
[6] Refer to Ridership and Revenue Technical Criteria and Methodology Memorandum for specific procedures.
[7] Refer to Capital Improvement Analysis Technical Criteria and Methodology Memorandum for specific procedures.

Exhibit 6: Identification of Infrastructure Requirements Using String Chart



The Vision Scenario was refined and described based on the following considerations:

- Service level adjustments given understanding of market capture potential for each corridor;
- Critical design requirements (run-times, line capacity, station configuration) for each corridor and generic projects meeting requirements given a pulsed operation;
- Delivery options and underlying trip time assumptions/mobility benefits for each corridor, and potential alternative delivery options (rail and express bus/urban mass transit);
- Capacity analysis of the envisioned service levels/frequencies and infrastructure to evaluate trade-offs between desired service and design requirements/delivery options;
- Freight quality based on freight flows analysis and freight train forecasts for each corridor; and
- Rough order-of-magnitude estimate of capital costs.



Caltrans prepared Netgraph representations of Service Plans under consideration. The Netgraph diagrams defined the types of service(s) provided in each corridor, the travel times between principal nodes, the frequencies of service and the coordination of transfer opportunities at identified timed transfer points.

A single “Demonstration Scenario” Netgraph was developed as a network proof of concept document for review with state rail stakeholders and as the basis for ridership analysis and quantification of “program effects” described in Chapter 6 of the State Rail Plan.

3. Final Service Plan Refinements and Vision

The outputs of Caltrans service plan refinement were further developed for presentation as a draft State Rail Network Vision for further review and refinement. This evaluation included review by rail stakeholders, capital improvement analysis to evaluate service goals and delivery options in a corridor based on high level costs for providing services, a statewide ridership analysis to evaluate the performance of the network and confirm that proposed services were tailored to expected market demand, and an estimate of operating costs associated with the integrated network to confirm that the integrated services and investments were meeting the state’s expectation for achieving operating efficiencies reducing operating costs consistent with documented examples of integrated systems elsewhere in the world.

<u>Stakeholder Outreach – *Term Sheets*</u>

Caltrans and CalSTA sought detailed feedback from rail stakeholder agencies around the state on the Draft Vision for the passenger rail network as a check on the technical analysis being performed and developed Term Sheet documents describing proposed service improvements and infrastructure assumptions in individual corridor segments for discussion purposes. The Term Sheets were used to divide the state rail network into service planning regions, or “geographies” conforming to the state’s understanding of regions and travel markets. These geographies in turn were used as the basis for analyzing capital improvements and developing capital cost “budgets” for service regions in the State Rail Plan.

Caltrans scheduled meetings with 29 individual stakeholder agencies around the state to present the Draft Vision and network assumptions and collect feedback for use in finalizing the Vision. The final Term Sheet document served as the basis for the description of passenger service goals and improvements in the Draft State Rail Plan, with subsequent updates based on the latest understanding of project development assumptions and costs.

Capital Cost Analysis

The 2040 Vision identifies the service type, frequency (system pulse), required average line speed, departure and arrival times, and route nodes used to develop corridor specific improvements and build related capital cost estimates. This Vision was used to identify capacity requirements at the corridor level throughout the State. These capacity requirements were the primary basis for all project descriptions and assumptions in the implementation cost estimate.

The service and connectivity goals, along with corridor-level improvements required to achieve the 2040 Vision, are described in a phased plan with capital projects identified for the near-term, i.e., the next four years (2022); and mid-term needs identified for the next decade (2027); along with improvements and investments for long-term (2040) planning. The Capital Cost methodology is documented as a separate document in the State Rail Plan Appendix. Note that the phases track with the Vision phasing process outlined in Exhibit 3.

- 2022, the Near-Term, catalogs the capital plan of ongoing and committed projects as part of an enhanced existing conditions assessment of present and near-term rail services across the State. Near-term projects totaled to $4.8 billion in Year 2018 dollars.
- 2027, the Mid-Term, captures new and established projects and planning studies intended to maximize capacity and utility of the existing passenger rail network, and begin using high-speed rail while connecting it to the statewide integrated network. Mid-term projects totaled to $47.0 billion.
- 2040, the long-term Vision, identifies additional corridor-level investments and service goals needed to fully realize the 2040 Vision, connecting regional networks into a statewide integrated system. 2040 Vision projects totaled to $85.0 billion.

More on specific projects and phasing of projects appears in Chapter 6.

Ridership Analysis

Caltrans prepared a macro-level ridership analysis using a Rail Market Analysis Tool developed by Steer Davies Gleave for the Rail Plan to document ridership effects of the long-term Vision and validate the scope of investment in an integrated statewide passenger rail network. The model was developed to capture rail and transit demand from changes in modal split driven by the key improvements in the Rail Plan, including higher service quality (increased speeds, higher frequencies, timed connections and minimal transfer times, and expanded coverage into additional markets). This tool utilized High Speed Rail network and demand matrix information, impedances and weights for Highway, Air, Rail/Transit modes to feed mode choice (cost, door to door travel time including transfers, number of transfers and frequencies – including weights to reflect future perception of an integrated system and improved service quality), mode split model coefficients from similar projects, literature research and recommendations for other model applications, and 2015/16 ridership data from NTD California operators to calibrate the model and provide post-processing adjustments. The model also accounted for additional demand not included in the model itself, including an external analysis of tourism-related trips and growth in market share using Visit California data, as well an induced demand analysis for rail trips avoided in a no-build scenario without improvements in the Rail Plan.

The model included coding for High Speed Rail, conventional long-distance, intercity and commuter rail systems, Demonstration Scenario services in the long-term Vision Netgraph, BART and LA Metro rail services, Light Rail services, Amtrak Thruway Bus routes, other major bus connections and ferry connections.

A summary of the ridership model outputs is included in Chapter 6 of the Rail Plan.

Appendix A.7
Capital Cost Methodology

Overview of Capital Cost Methodology

Definitions

Rough-Order-of-Magnitude Cost Estimate: an estimate prepared during the pre-design stage when the project is between 0 and 5 percent design development.

Construction Costs: Costs to construct the project, including the labor, equipment, and material costs; subcontractors' overhead and profit; and the general contractor's overhead and profit.

Project Costs: Complete project cost, including the construction costs, right-of-way acquisitioning, design, construction and project management fees, and professional services.

Escalation: An adjustment factor that is meant to account for annual labor and commodity increases in construction materials, labor, and professional services.

Allocated Contingency: Also known as design contingency, this is an allowance carried in the estimate detail that accounts for expected design development and unknowns at the time of the estimate.

Unallocated Contingency: Also known as construction contingency, this is an allowance carried at the executive summary level to account for unexpected changes that may occur during construction, including unknown or undocumented site conditions.

Urban Rail: Passenger transportation on rail in urban areas, including light rail transit and heavy rail transit (BART and LA Metro.) Only specific urban rail projects that are considered to be significant regional connectors are included in the State Rail Plan.

Intercity Rail (Also referred to as Regional Rail and Commuter Rail): Passenger transportation on rail that connects two or more cities, typically longer distances than Urban Rail (Amtrak, Metrolink, Caltrain.)

High-Speed Rail: Passenger transportation on HSR infrastructure. This includes projects in the California High Speed Rail (CSRP) and the Xpress West project (XpressWest). The State Rail Plan contains the entire CSRP program, including Phase 1 under construction, Phase 1 planned, and

Phase 2 planned. The XpressWest project includes two segments: the Victorville to Las Vegas segment published by Xpress West, and a connection from Victorville to Palmdale.

Introduction

This document is an Independent Cost Estimate and Cost Methodology Report prepared by AECOM for the 2018 California State Rail Plan. This estimate is a high-level rough-order-of-magnitude estimate based on an assortment of projects that are at the 0 percent design stage. The costs provided in this estimate are at the corridor level, and are not meant to represent individual projects. It is expected that these corridor-level totals will be subdivided into projects and phases as part of project implementation planning and design development. No design has been performed at this time at the project level.

This technical memorandum is intended to meet the following goals as defined by Caltrans and AECOM:

- Document the methodology and criteria used to complete the capital cost estimate.
- Present the rough-order-of-magnitude capital cost estimate figures.
- Provide detailed assumptions, project elements, unit prices, and pricing sources for review by the Caltrans team.

Purpose

This document presents the rough-order-of-magnitude capital costs for the proposed infrastructure improvements associated with the 2018 Rail Plan. This document presents the methodology used in preparing the costs, as well as the estimate criteria, pricing sources, and assumptions. This estimate is representative of the most realistic price under stable bidding conditions for a project with the given assumptions and criteria. Any variance to the assumptions listed in this report could be the cause for a variance in the design and construction costs for the corridor improvements. This estimate is not intended to be a prediction of an under-designed system or a low-bid estimate. Likewise, this estimate is not intended to be a prediction of an over-designed system or open ended contract.

This document was prepared with the intended purpose of providing a strategic planning overview of the estimated probable capital cost of completing the program of projects needed to achieve the vision of an integrated passenger rail network and improved freight rail system supporting the stated goals of the California Transportation Plan 2040.

Estimate Methodology and Criteria

Estimate Methodology

Estimate Level

The estimates of probable capital costs at this stage include planning-level estimates of cost that take into consideration factors such as complexity, environment, geographic location (urban, suburban, rural), proximity to active tracks, and other such factors that may significantly influence the costs. Therefore, planning-level estimates of probable cost are gross-order-of-magnitude estimates intended to be indicative and inform the prioritization of investment decisions, and are not to be interpreted as engineer estimates.

Estimate Format

The estimate of probable cost is presented with totals listed by corridor-level improvements. These costs are summarized into improvements by region. Key quantities are given for each corridor to identify the essential project elements. Corridor estimates are based on either sourced information, or built up using a capital cost unit price catalog. This catalog follows the FRA Standardized Cost Categories (SCC), with unit costs for typical elements identified based on an average project cost. For unique high-cost improvements such as intercity stations, local stops, regional terminals, and major iconic intermodal hubs, maintenance yards, shops, and administrative buildings, a lump sum opinion of cost is assumed based on a range of low, medium, and high comparable costs derived from recent projects of similar scope.

Estimate Procedure

Step 1 – Capacity Charts/Network Graphs:

The 2040 Strategic Service Plan service type, frequency (system pulse), required average line speed, departure and arrival times, and route nodes used to develop corridor-specific improvements and build related capital cost estimates. This service plans were used to identify capacity requirements at the corridor level throughout the state. These capacity requirements are the primary basis for all project descriptions and assumptions in this estimate.

Step 2 – Corridor Investigation:

The corridors were investigated by a visual survey of the existing infrastructure using a combination of Google Earth mapping and consulting team professional knowledge of the existing conditions. The existing infrastructure was compared with future capacity requirements from the Capacity / Network charts. The planning team then compared the existing infrastructure to the future capacity requirements to identify the specific project components.

Step 3 – Pricing Research and Create Corridor Estimates:

An estimate of probable capital cost was prepared for each corridor by using sourced data or building up a cost estimate by using sourced information, or using a capital cost unit price catalog.

The cost catalog identified a "menu" of prototypical improvements, consisting of approximately 30 elements. Unit costs were developed for each element, using historical cost data from other projects. Cost factors, mark-ups, and adjustments were added as needed to develop pricing for new impacts not previously included in estimates, and / or adjust prior cost estimates to reflect a consistent cost estimate system.

For costs that are not sourced, corridor estimates were built up using the cost catalog. The corridor estimate applied unit costs to the programmatic project developments identified in Step 2. Measurements were taken to determine lengths (in route miles) of guideway type with assumptions for at-grade, aerial, or underground alignment.

Estimate Criteria

Pricing Sources and Standard Cost Categories

Sourced Projects

- 2016 Draft CAHSRA Business Plan (2016)
- Capitol Corridor 2014 Vision Plan Update Final Report (2014)
- Redlands Passenger Rail Project Fact Sheet (2015)
- XpressWest Media Kit (2011)

Cost Catalog

Unit costs have been developed from historical cost data, both internal and gathered from due diligent research. Many unit prices are based on the average or more conservative higher-end of the statistical averages. All costs have been appropriately adjusted with location and escalation factors to be comparable to California in the Plan Year of 2018.

10 Track Structures & Track – includes elevated structures (bridges and viaducts), embankments and open cuts, retaining wall systems, tunnels, culverts and drainage, track (ballasted and non-ballasted), and special trackwork. Unit costs are averages based on cost estimates and bid results from Caltrain, Metrolink, BART, and LA Metro. Pricing is included for new single track, new double track, and relocation of existing track.

20 Stations, Terminals, Intermodal – includes rough grading, excavation, station structures, enclosures, finishes, equipment; mechanical and electrical components including heating, ventilation, and air conditioning; station power, lighting, public address/customer information systems; and safety systems such as fire detection and prevention, security surveillance, access control, and life safety systems. Unit costs are averages based on cost estimates and bid results from Caltrain, Metrolink, BART, and LA Metro. A range of costs has been used depending on the intent of the design, with a range from low, medium, and high, to iconic. Iconic refers to a major hub such as Los Angeles Union Station or San Francisco's Transbay Terminal.

30 Support Facilities: Yards, Shops, Administration Buildings – includes rolling stock service, inspection, storage, heavy maintenance and overhaul facilities and equipment, as well as associated yard tracks and electrification. In addition, maintenance-of-way facilities are also included in this cost category. Unit costs are averages based on cost estimates and bid results from Caltrain, Metrolink, BART, and LA Metro. A range of costs has been used, depending on the intent of the design, ranging from low to and high.

40 Sitework, Right-of-Way, Land, Existing Improvements – includes cost of demolition, hazardous materials removals, environmental mitigation, utility relocations, noise mitigation, intrusion protection, grade separations, roadway improvements, acquisition of real estate, and temporary facilities and other indirect costs.

50 Systems – includes all costs of implementing Automatic Train Control (ATC) systems, inclusive of Positive Train Control (PTC) and intrusion detection, where it is applicable. Includes costs of traction power supply system such as supply, paralleling, and switching substations, as well as connections to the power utilities; and traction power distribution system in the form of Overhead Contact System (OCS). Unit costs are averages based on cost estimates and bid results from Caltrain, Metrolink, BART, and LA Metro. Unit costs are averages based on cost estimates and bid results from Caltrain, Metrolink, BART, and LA Metro. A range of costs has been used depending on the geography of the design, ranging from rural and suburban to urban. A sitework cost has been included for every mile of at-grade, aerial, and underground construction.

60 Right-of-Way – Land acquisition purchase required for guideway, stations, and facilities. Unit costs are based on the California High Speed Rail Authority's Business Plan. Urban right-of-way is estimated at 90 percent of the costs for the San Francisco to San Jose segment. Suburban right-of-way costs are 67 percent of the San Francisco to San Jose cost. Rural San Francisco to San Jose costs are estimated at 25 percent of the San Francisco to San Jose cost.

70 Vehicles – includes costs for acquisition of the trainsets (design, prototype unit, and production and delivery of trainsets to the project site on an annual basis). This estimate excludes all rolling stock.

80 Professional Services – includes all professional, technical, and management services related to the design and construction of infrastructure (Categories 10 through 60) during the preliminary engineering, final design, and construction phases of the project/program (as applicable). A 30 percent mark-up has been used to account for all professional services.

Contingency

Allocated Contingency (or Pre-Construction Design Development)

Allocated contingency represents a percentage of unknown or undeveloped scope that has not been implemented into the design documents. Because there is no design on any project, this estimate uses the maximum of 30 percent contingency. This contingency is expected to be reduced when the projects are designed.

Unallocated Contingency (or Change Order Contingency)

Unallocated contingency added to the construction and professional services costs at 10 percent of the estimate. Unallocated contingency represents costs above and beyond in the project budget, for such changes that are likely to occur during the construction. The construction contingency allowance carried by the owner in the project budget should remain constant throughout the design process.

Contract Procurement & Construction Fee

No assumptions have been made regarding contract procurement and delivery method. The unit costs include appropriate allowances to cover contractor fees, overhead, general conditions, and general requirements. The FRA format does not include a specific location for the contractor's General Conditions; therefore, the contractor's General Conditions have been included throughout the estimate at the unit cost level.

Cost Basis Year

AECOM established 2018 as the base year of all the cost estimates prepared for the 2018 Rail Plan. Any previous data that have a different base year—for example, Sepulveda Pass Final Compendium Report (2012), Capital Corridor 2014 Vision Plan Update Final Report, and 2016 Draft CAHSRA Business Plan—have been adjusted to match the base year established for the 2018 Rail Plan.

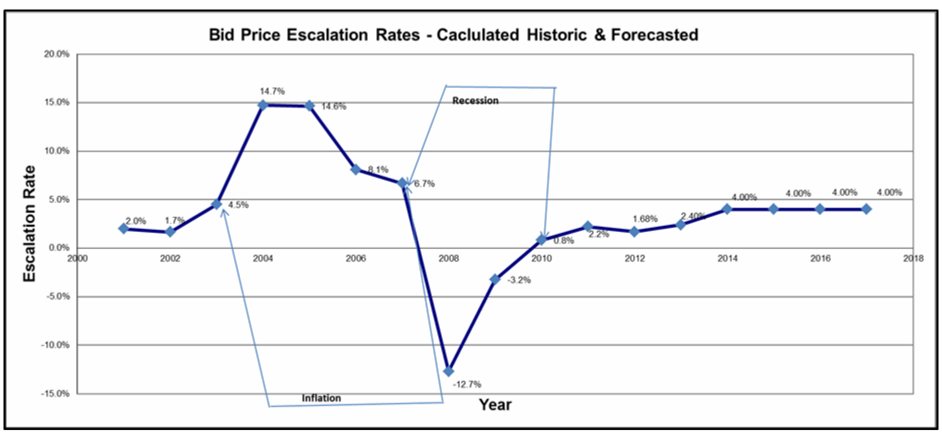
Cost Escalation Methodology and Calculations

The regional rail/commuter rail unit prices in the estimate detail are priced in 2018 value. Any sourced project data have been escalated from the published report date to the year 2018. An adjustment for cost escalation has been added to account for the anticipated cost increases between the published date and the 2018 cost basis year.

The HSR unit prices in the estimate detail are also priced in future value of the cost basis year. However, the adjustment for cost escalation has been performed at the summary level to account for the anticipated cost increases between the CAHSRA report year (2016) and the cost basis year (2018). The sum of the main elements has been escalated by 4 percent annually.

Escalation adjustment is meant to account for normal market growth across the state. The long-range annual escalation factor has been calculated by aggregating escalation procured from several government and consulting sources, including California Department of Transportation, American General Contractors, Turner Construction, Cumming Corporation, Davis Langdon, Engineering News Record, and the Los Angeles Bureau of Engineering. The average escalation factor calculated when aggregating the data is 3.99 percent. This estimate rounds the escalation rate up to 4 percent per year for long-range estimating purposes. Table A.29 depicts the reference long-term escalation rates, sources, and the average escalation rate of all the reference sources.

The following graph shows the average annual escalation data during the past 12 years, and the projected escalation rates through 2018.



Sources: Escalation rates have been calculated by aggregating long-range historic trends and forecasts from the following sources: Caltrans Average Highway Contract Prices 2000-2012, ENR- LA BCI & CCI 2000-2012, AGC Construction & Materials Outlook, May 1, 2013.

Qualifications

- This estimate should be used for high-level visioning purposes only, and not for grant applications or other decision making for specific projects.
- Any flaws or errors in the ridership modeling or production of the network graphs are carried through, and affect the estimate totals.
- Actual project costs could range +/- 30 percent.

Appendix A.8 Long-Term Vision Demonstration Scenario Netgraph

2018 california state rail plan

California State Rail Plan: Long-Term Vision Demonstration Scenario

Version 1-10

2111 | hpo, ule

Revisions

Version	Date	By	Details	Reviewed: Name	Reviewed: Signature	Authorized: Name	Authorized: Signature	Comments
1-10	May 24, 2018	ule						

Disclaimer

This Netgraph displays core services only. It is assumed that complementary or infrequent services would also run. These would include:

- Complementary High Speed Rail services providing non-stop connections between the Bay Area and Southern California.
- Complementary Regional and Commuter services providing additional services on regional and commuter corridors.
- Infrequent services: these may include seasonal or market driven services and Amtrak long distance services.

Legend

Nodes

Note: The netgraph is precise to the nearest 5 minutes - only simplified arrival and departure times are shown

Arrival Minute
Departure Minute
(Only 5 minute precision is shown)

Bi-hourly Service:
Serif, italic minute font: odd hour
Sans-serif, normal font: even hour

Half-hourly Service:
Only one set of departure and arrival minutes are shown. The second train operates at an offset of exactly 30 minutes to the displayed minute.

Example:
Arrival from C at minute 50
Departure to A at minute 55 (5 minute transfer)
From B to C: arr. 55, dep. 10 (15 minute transfer)
From C to B: arr. 50, dep. 05 (15 minute transfer)
From A to C: arr. 05, dep 10 (5 minute transfer)
Note: Dwell times are not defined.

Service Path
Splitting/ Joining

1 or more inbetween stops

Service Categories

High Speed Rail [HSR]
Blended Service
Intercity/ Express [ICE]
Regional/ Local [REG]
Bus
Ferry
Light Rail/ Metro [URT]
(Service intervals not shown)

Frequency (System Pulse)

Infrequent Service (>240 Minute Interval)
240 Minute Interval
120 Minute Interval
60 Minute Interval
30 Minute Interval

Required Average Line Speeds

This value includes dwell times at yet to be defined stations between main nodes.

120 mph
65 mph

Assumed stopping distance ranges:
HSR: Based on CaHSRA plans
IC: 20-50 miles
REG: 3-6 miles

In this example:
HSR runs with an average speed of 120 mph (including dwells) between the nodes.
IC runs with an average speed of 65 mph (including dwells) between the nodes.

Appendix A.9 Emissions Inventory Analysis Supporting Information

Emissions Inventory Analysis Supporting Information

The emission analysis described here was conducted in December 2016 using data available at that time. [10]

2010 and 2040 Freight Locomotive Emissions Analysis

Emission rates by certification tier used for freight locomotives are reported in Table A.19, and the locomotive fleet make-up is presented in Table A.20. Weighted emission rates, in terms of grams per gallon of diesel, are shown in Table A.21.

Freight activity was provided in terms of estimated ton-miles in each air basin for 2013, 2040, and "2040-High." Straight line interpolation was used to extrapolate 2011 ton-miles, and converted to fuel consumption, then scaled to match the most recent California Air Resources Board (CARB) estimated fuel consumption estimate of 210 million gallons of fuel consumed annually[11]. Estimated ton-miles and scaled fuel consumption were extrapolated for a 2010 baseline year; and scaled fuel economy was estimated for the 2040 and "2040-high" activity estimates (Table A.22). Estimated emissions from freight were estimated by combining these fuel consumption data with the emission rates (Table A.23)[12].

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[10] The California Air Resources Board (CARB) has released a locomotive emissions inventory dated October 2017. That update was based on proprietary data that CARB was unable to share in advance do to confidentiality agreements between CARB and the railroads, and that October 2017 information it is not reelected in the 2018 CSRP. In general, CARB's 2017 inventory data show slightly lower fuel use and emissions estimates. In that sense, results presented in the 2018 CSRP are conservative and appropriate for the purpose and intent of the document.

[11] Nicole Dolney and M. Malchow, (2014) Locomotive Inventory Update: Line Haul Activity, CARB tech distribution ref. (Presentation), 2014, California Air Resources Board.

[12] The California Air Resources Board (CARB), has released a locomotive emissions inventory dated October 2017. That update was based on proprietary data that CARB was unable to share in advance due to confidentiality agreements between CARB and the railroads, and that October 2017 information is not reflected in the 2018 Rail Plan. In general, CARB's 2017 inventory data show slightly lower fuel use and emissions estimates. In that sense, results presented in the 2018 Rail Plan are conservative and appropriate for the purpose and intent of the document.

2010 and 2040 Passenger Locomotive Emissions Analysis

Passenger locomotive emissions were estimated, first assuming no electrification based on existing CARB passenger locomotive data, [13,14] and scaling factors based on estimated passenger miles of travel (PMT) in each air basin (Table A.24, Table A.25, and

Table A.26). This approach implicitly assumes the mix of locomotive technologies assumed by CARB. The 2035 inventory was used directly to represent 2040, assuming there would not be changes to the locomotive fleet and train schedules between 2035 and 2040. Subsequent adjustments are made on these tables to account for electrification. Statewide emissions from the CARB inventory were used as a control total; emissions were allocated to each air basin based on the relative distribution of passenger miles of travel in each air basin.

Table A.27 provides PMT data used to scale the CARB emissions inventory. The 2040 with-demonstration data were broken out into electric and diesel operation by assuming that in the San Joaquin Valley, Mojave Desert, San Francisco Bay Area, South Coast, and San Diego, 100 percent of the increases in PMT sources in 2040 (relative to 2040 no plan, and 50 percent of the 2010 to 2040 growth without the demonstration plan) would be electrified and have zero emissions. Table A.28 then presents the 2040 with-demonstration emissions assuming electrification.

CO_2 emissions from electric power generation were then incorporated into the draft CSRP. Estimates were based on the megawatt-hours required to power locomotives in each air basin; and emission factors for power generation assuming California's Renewable Portfolio Standard. The final draft will present emissions assuming that all of the electricity used to power the system will be generated from renewable resources such as solar and wind.

2010 and 2040 On-Road Vehicle Emissions Analysis

On-road emissions were estimated based on emissions for 2010 and 2040 that were calculated using EMFAC 2014, run for each air basin in California. For passenger vehicles, emission rates were derived from EMFAC and applied to passenger-vehicle miles of travel estimates from the CSRP, by air basin. 2010 and 2040 passenger vehicle miles of travel, without the 2040 rail plan, were scaled to match EMFAC 2014 estimates. Scaling is necessary because the statewide travel demand model network is courser than the regional model networks that EMFAC default vehicle miles of travel (VMT) is based on. The 2040 scaling factor was then applied to the reduced 2040

[13] For criteria pollutants: CARB (2016) ARB's Emission Inventory Activities, California Air resources Board, Accessed 2016).

[14] For CO_2: Statewide total based on June 2016 California GHG Inventory, less estimated freight CO_2 emissions.

passenger vehicle VMT with the CSRP, and the resulting VMT was used in estimating with CSRP emissions. Commercial vehicle VMT and emissions were taken directly from EMFAC 2014.

Table A.29 shows the resulting vehicle emissions inventory for 2010, 2040, and 2040 with the CSRP.

2020 and 2025 Emissions

Straight line interpolation was used to estimate emissions for intermediate analysis years.

Table A.30 and Table A.31 show estimated grams of carbon dioxide emitted per passenger mile of travel from passenger locomotives and on-road passenger vehicles; these data are derived from the preceding tables.

Table A.19: Freight Locomotive Emission Factors

Certification	Manufacture	g/bhp-hr					
Tier	Year	CO2	ROG	NOx	CO	PM10	PM2.5
Pre Tier	Pre 1973	491.20	0.48	13.00	1.28	0.32	0.310
Tier 0	1973-2001	491.20	0.48	8.60	1.28	0.32	0.310
Tier 0r	2008+	491.20	0.30	7.20	1.28	0.20	0.194
Tier 1	2002-2004	491.20	0.47	6.70	1.28	0.32	0.310
Tier 1r	2008+	491.20	0.29	6.70	1.28	0.20	0.194
Tier 2	2005	491.20	0.26	4.95	1.28	0.18	0.175
Tier 2r	2008+	491.20	0.13	4.95	1.28	0.08	0.078
Tier 3	2012-2014	491.20	0.13	4.95	1.28	0.08	0.078
Tier 4	2015+	491.20	0.04	1.00	1.28	0.015	0.015
Certification	**Manufacture**	**g/gal @ 20.8 bhp-hr/gal**					
Tier	**Year**	**CO2**	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**
Pre Tier	Pre 1973	10217	9.98	270.40	26.62	6.66	6.448
Tier 0	1973-2001	10217	9.98	178.88	26.62	6.66	6.448
Tier 0r	2008+	10217	6.24	149.76	26.62	4.16	4.035
Tier 1	2002-2004	10217	9.78	139.36	26.62	6.66	6.448
Tier 1r	2008+	10217	6.03	139.36	26.62	4.16	4.035
Tier 2	2005	10217	5.41	102.96	26.62	3.74	3.640
Tier 2r	2008+	10217	2.70	102.96	26.62	1.66	1.622
Tier 3	2012-2014	10217	2.70	102.96	26.62	1.66	1.622
Tier 4	2015+	10217	0.83	20.80	26.62	0.312	0.312

Source: EPA *Emission Factors for Locomotives*, (2009), EPA-420-F-09-025.

Table A.20: Freight Locomotive Fleet Certification Mix

Certification Tier	Without SCAB MOU			With SCAB* MOU (Used for SCAB)			Avg. of SCAB & Non-SCAB Fleet (Used outside of SCAB)		
	2010	2013	2040	2010	2013	2040	2010	2013	2040
Pre-Tier									
Tier 0	47.6%	18.8%		20.5%	10.4%		34.05%	14.60%	
Tier 0r	21.4%	40.7%		9.7%	24.4%		15.55%	32.55%	
Tier 1	8.4%	3.5%		3.7%	2.6%		6.05%	3.05%	
Tier 1r	3.8%	9.0%	1.4%	1.9%	4.8%	1.4%	2.85%	6.90%	1.4%
Tier 2	18.8%	18.5%		64.2%	38.6%		41.50%	28.55%	
Tier 2r		2.5%	5.4%		5.4%	5.4%		3.95%	5.4%
Tier 3		7.0%	9.2%		13.8%	9.2%		10.40%	9.2%
Tier 4			84.0%			84.0%			84.0%

* SCAB = South Coast Air Basin

Source: Nicole Dolney and M. Malchow (2014) Locomotive Inventory Update: Line Haul Activity, CARB tech distribution ref. (Presentation), November 7, 2014, California Air Resources Board.

Table A.21: Weighted Emission Rates for Freight Locomotives

Pollutant	Without SCAB MOU			With SCAB* MOU (Used for SCAB)			Avg. of SCAB & Non-SCAB Fleet (Used outside of SCAB)		
	2010	2013	2040	2010	2013	2040	2010	2013	2040
CO2 (g/gal)	10,217	10,217	10,217	10,217	10,217	10,217	10,217	10,217	10,217
ROG (g/gal)	8.15	6.56	1.18	6.60	5.71	1.18	7.38	6.14	1.18
NOx (g/gal)	153.55	140.83	34.46	125.10	124.97	34.46	139.33	132.90	34.46
CO (g/gal)	26.62	26.62	26.62	26.62	26.62	26.62	26.62	26.62	26.62
PM10 (g/gal)	5.48	4.40	0.56	4.50	3.84	0.56	4.99	4.12	0.56
PM2.5 (g/gal)	5.31	4.27	0.56	4.37	3.73	0.56	4.84	4.00	0.56

Table A.22: Estimated Annual Gallons of Diesel Consumed by Freight Operations (in millions)

Air Basin	2010	2040	2040 High
Mojave Desert	71.0	101.0	104.1
Mountain Counties	14.4	25.2	25.2
North Central Coast	1.4	2.2	2.2
Northeast Plateau	5.3	7.1	7.1
Sacramento Valley	21.9	31.8	31.8
Salton Sea	4.9	7.3	8.8
San Diego County	1.9	3.0	3.0
San Francisco Bay	7.8	14.3	14.3
San Joaquin Valley	45.0	62.7	62.7
South Central Coast	3.3	3.9	3.9
South Coast	30.5	44.6	58.5

Table A.23: Estimated Freight Locomotive Emissions

Pollutant	Bay Area & N Cal	Greater LA and LOSAN South	LOSAN North and Central Coast	Xpress West and Inland Empire	Cantal Valley	Total
2010 Freight Locomotive Emissions (Tons/Day)						
CO2	1,525	997	144	2,343	1,390	6,399
ROG	1.10	0.65	0.10	1.69	1.00	4.55
NOx	20.79	12.29	1.96	31.95	18.95	85.95
CO	3.97	2.60	0.37	6.11	3.62	16.67
PM10	0.74	0.44	0.07	1.14	0.68	3.08
PM2.5	0.72	0.43	0.07	1.11	0.66	2.99
2040 (Low Activity) Freight Locomotive Emissions (Tons/Day)						
CO2	2,420	1,470	189	3,343	1,935	9,356
ROG	1.75	0.96	0.14	2.41	1.40	6.65
NOx	33.00	18.12	2.57	45.58	26.38	125.67
CO	6.31	3.83	0.49	8.71	5.04	24.38
PM10	1.18	0.65	0.09	1.63	0.94	4.50
PM2.5	1.15	0.63	0.09	1.58	0.92	4.37
2040 (High Activity) Freight Locomotive Emissions (Tons/Day)						
CO2	2,420	1,896	189	3,483	1,935	9,923
ROG	1.75	1.23	0.14	2.52	1.40	7.03
NOx	33.00	23.35	2.57	47.50	26.38	132.81
CO	6.31	4.94	0.49	9.08	5.04	25.86
PM10	1.18	0.84	0.09	1.70	0.94	4.76
PM2.5	1.15	0.81	0.09	1.65	0.92	4.62

Table A.24: 2010 Passenger Locomotive Emissions without Plan (based on CARB 2010 statewide inventory) [15]

	Bay Area & N Cal	Greater LA and LOSSAN South	LOSSAN North and Central Coast	Xpress West and Inland Empire	Central Valley	Total
CO_2 (Tons/Day)	*283.62*	*109*	*8*	*2*	*138*	541
ROG (Tons/Day)	*0.30*	*0.12*	*0.01*	*0.00*	*0.15*	0.58
NO_x (Tons/Day)	*5.28*	*2.04*	*0.16*	*0.04*	*2.56*	10.08
CO (Tons/Day)	*0.46*	*0.18*	*0.01*	*0.00*	*0.22*	0.87
PM_{10} (Tons/Day)	*0.11*	*0.04*	*0.00*	*0.00*	*0.05*	0.21
$PM_{2.5}$ (Tons/Day)	*0.10*	*0.04*	*0.00*	*0.00*	*0.05*	0.20
Passenger miles traveled	2,025,908	781,541	59,433	14,881	982,879	3,864,641

Table A.25: 2040 Passenger Locomotives Emissions without Plan (based on CARB 2035 statewide inventory) [16]

	Bay Area & N Cal	Greater LA and LOSSAN South	LOSSAN North and Central Coast	Xpress West and Inland Empire	Central Valley	Total
CO_2 (Tons/Day)	572.15	136	11	3	345	1,068
ROG (Tons/Day)	0.44	0.10	0.01	0.00	0.26	0.82
NO_x (Tons/Day)	7.69	1.83	0.15	0.05	4.64	14.35
CO (Tons/Day)	0.67	0.16	0.01	0.00	0.40	1.25

[15] The CSRP emissions analysis had to be completed before January 2017 using data that was available durig the fall of 2016. For the most updated passenger locomotive inventory please visit: https://www.arb.ca.gov/msei/ordiesel.htm

[16] The CSRP emissions analysis had to be completed before January 2017 using data that was available durig the fall of 2016. For the most updated passenger locomotive inventory please visit: https://www.arb.ca.gov/msei/ordiesel.htm

	Bay Area & N Cal	Greater LA and LOSSAN South	LOSSAN North and Central Coast	Xpress West and Inland Empire	Central Valley	Total
PM10 (Tons/Day)	0.16	0.04	0.00	0.00	0.10	0.30
PM2.5 (Tons/Day)	0.15	0.04	0.00	0.00	0.09	0.28
Passenger miles traveled	4,086,958	973,808	80,275	24,320	2,465,647	7,631,007

Table A.26: 2040 Passenger Locomotives Emissions with Plan (based on PMT scaling of 2040 no plan data and <u>no electrification</u>)

	Bay Area & N Cal	Greater LA and LOSSAN South	LOSSAN North and Central Coast	Xpress West and Inland Empire	Central Valley	Total
CO2 (Tons/Day)	2,968	3,777	104	1,575	5,578	19,849
ROG (Tons/Day)	2.28	2.90	0.08	1.21	4.28	14.34
NOx (Tons/Day)	39.87	50.74	1.40	21.15	74.93	266.62
CO (Tons/Day)	3.47	4.42	0.12	1.84	6.53	21.97
PM10 (Tons/Day)	0.83	1.06	0.03	0.44	1.57	4.97
PM2.5 (Tons/Day)	0.78	0.99	0.03	0.41	1.46	4.87
Passenger miles traveled	21,204,118	26,982,374	742,253	11,246,981	39,845,493	100,021,220

Table A.27: 2040 Passenger Miles of Travel by Air Basin

Air Basin	2010 Baseline	2040 No-Build	2040 Demonstration (Total)	2040 Demonstration (Electric)	2040 Demonstration (Diesel)
North Coast			62,368		62,368
Northeast Plateau					
Sacramento Valley	277,149	533,131	4,537,482	4,132,342	405,140
Mountain Counties	1,226	1,838	38,644		38,644
Lake County					
Lake Tahoe					
Great Basin Valleys					
San Joaquin Valley	982,879	2,465,647	39,845,493	38,121,231	1,724,263
North Central Coast	8,422	15,900	520,998		520,998
Mojave Desert	14,375	24,006	10,784,900	10,765,710	19,190
South Central Coast	51,011	64,375	221,255		221,255
Salton Sea	506	313	462,081		462,081
San Francisco Bay	1,747,533	3,551,989	16,565,624	13,915,864	2,649,761
South Coast	721,824	896,862	22,674,116	21,864,773	809,343
San Diego County	59,717	76,946	4,308,258	4,239,927	68,331
Total	*3,864,641*	*7,631,007*	*100,021,220*	93,039,845	6,981,375
Aggregated to Planning Areas					
Bay Area & N Cal	2,025,908	4,086,958	21,204,118	18,048,205	3,155,913

Air Basin	2010 Baseline	2040 No-Build	2040 Demonstration (Total)	2040 Demonstration (Electric)	2040 Demonstration (Diesel)
Greater LA and LOSAN South	781,541	973,808	26,982,374	26,104,700	877,674
LOSAN North and Central Coast	59,433	80,275	742,253		742,253
Xpress West and Inland Empire	14,881	24,320	11,246,981	10,765,710	481,271
Cantal Valley	982,879	2,465,647	39,845,493	38,121,231	1,724,263

Bay Area and N. Cal = North Coast, Northeast Plateau, Sacramento Valley, Mountain Counties, Lake County, Lake Tahoe, San Fran cisco Bay Area
Greater LA and LOSAN South = South Coast, San Diego County
LOSAN North and Central Coast = North Central Coast, South Central Coast
Xpress West and Inland Empire = Great Basin Valleys, Mojave Desert, Salton Sea
Central Valley = San Joaquin Valley

Table A.28: 2040 Passenger Locomotives Emissions with Plan (based on PMT scaling of 2040 no plan data, <u>with electrification</u>)

	Bay Area & N Cal	Greater LA and LOSAN South	LOSAN North and Central Coast	Xpress West and Inland Empire	Central Valley	Total
CO_2 (Tons/Day)	441.81	123	104	67	241	977
ROG (Tons/Day)	0.34	0.09	0.08	0.05	0.19	0.75
NO_x (Tons/Day)	5.93	1.65	1.40	0.91	3.24	13.13
CO (Tons/Day)	0.52	0.14	0.12	0.08	0.28	1.14
PM_{10} (Tons/Day)	0.12	0.03	0.03	0.02	0.07	0.27
$PM_{2.5}$ (Tons/Day)	0.12	0.03	0.03	0.02	0.06	0.26
Diesel Passenger miles traveled	3,155,913	877,674	742,253	481,271	1,724,263	6,981,374

Table A.29: Emissions Based on EMFAC 2014 Emissions Inventory Scaled by Changes in Passenger Vehicle (LDA, LDT1, LDT2, MDV, MC) VMT in Each Air Basin

	Bay Area & N Cal	Greater LA and LOSAN South	LOSAN North and Central Coast	Xpress West and Inland Empire	Central Valley	Total
2010 Baseline (Tons/Day)						
CO2 (Tons/Day)	140,463	238,338	27,627	34,394	62,532	503,353
ROG (Tons/Day)	149.0	207.7	30.8	34.0	59.5	480.98
NOx (Tons/Day)	352.1	469.3	67.6	116.1	225.1	1,230.13
CO (Tons/Day)	1,201.9	1,793.2	256.3	279.1	439.4	3,969.91
PM10 (Tons/Day)	22.5	34.6	4.3	6.5	12.0	79.99
PM2.5 (Tons/Day)	13.3	19.5	2.5	4.4	8.3	47.90
VMT	253,744,662	425,988,835	50,814,352	55,250,354	93,058,417	878,856,620
2040 No Plan (Tons/Day)						
CO2 (Tons/Day)	106,453	185,041	19,051	32,252	62,980	405,777
ROG (Tons/Day)	30.3	50.6	5.7	8.3	12.8	107.73
NOx (Tons/Day)	57.7	87.5	8.9	17.4	44.4	215.93
CO (Tons/Day)	199.2	357.2	38.1	59.9	84.7	739.10
PM10 (Tons/Day)	18.9	32.0	3.6	5.0	9.1	68.52
PM2.5 (Tons/Day)	7.7	13.1	1.5	2.0	3.7	28.06
VMT	327,697,848	554,658,688	62,930,263	81,789,654	149,282,777	1,176,359,230
2040 with Plan (Tons/Day)						
CO2 (Tons/Day)	104,429	179,830	18,259	31,540	59,032	393,090
ROG (Tons/Day)	29	49	5	8	11	102.99
NOx (Tons/Day)	57	87	9	17	44	213.80
CO (Tons/Day)	194	344	36	58	75	707.27
PM10 (Tons/Day)	18	31	3	5	8	65.82
PM2.5 (Tons/Day)	8	13	1	2	3	26.96
VMT	318,824,265	533,299,372	59,560,214	78,670,294	132,319,796	1,122,673,942

	Bay Area & N Cal	Greater LA and LOSAN South	LOSAN North and Central Coast	Xpress West and Inland Empire	Central Valley	Total
Plan Emission Reduction Benefit (Tons/Day)						
CO2 (Tons/Day)	2,024	5,211	792	712	3,948	12,687
ROG (Tons/Day)	0.77	1.93	0.31	0.31	1.42	5
NOx (Tons/Day)	0.34	0.85	0.16	0.16	0.62	2
CO (Tons/Day)	5.08	13.10	2.11	2.14	9.40	32
PM10 (Tons/Day)	0.45	1.07	0.17	0.16	0.85	3
PM2.5 (Tons/Day)	0.18	0.44	0.07	0.06	0.35	1
VMT	8,873,582	21,359,317	3,370,049	3,119,360	16,962,981	53,685,288

Table A.30: Passenger Locomotive Emissions per Passenger Mile Traveled (g/PMT)

	2010 baseline (g/PMT)	2040 no plan (g/PMT)	2040 demonstration (g/PMT)
CO2	127.00	127.00	8.86
ROG	0.14	0.10	0.01
NOx	2.37	1.71	0.12
CO	0.20	0.15	0.01
Exhaust PM10	0.05	0.04	0.00
Exhaust PM2.5	0.05	0.03	0.00

Table A.31: Passenger Vehicle Emissions per Passenger Mile Traveled (g/PMT)

	2010	2040
Trip length	5.50	4.93
CO2	363	179
ROG	0.38	0.07
NOx	0.34	0.03
CO	3.28	0.46
PM10	0.04	0.04
PM2.5	0.02	0.02

Based on assumed vehicle occupancy of 1.2 passengers per vehicle

Appendix A.10 Air Quality Analysis Methodology

Appendix A.10
Air Quality Analysis Methodology

List of Acronyms

bhp-hr/gal	Brake Horsepower-Hour per Gallon
CARB	California Air Resources Board
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSRP	California State Rail Plan
EMFAC	Emission Factors
g/bhp-hr	Grams per Brake Horsepower-Hour
GHG	Greenhouse Gas
NOx	Oxides of Nitrogen
PM_{10}	Large Respirable Particles
$PM_{2.5}$	Fine Particles
ROG	Reactive Organic Gases
USEPA	U.S. Environmental Protection Agency
VMT	Vehicle Miles of Travel

This memorandum presents the consultant team's proposed methodology for passenger and freight rail system air quality (greenhouse gas (GHG) and criteria pollutants) analysis for the 2018 California State Rail Plan (CSRP). This effort will analyze changes in on-road motor vehicle and locomotive emissions resulting from passenger and freight rail service and infrastructure modifications. The team will present the air quality analysis results as part of CSRP Section 4.4: Program Effects.

The analysis will replicate the 2013 CSRP's on-road motor vehicle emissions analysis. A new addition to the 2018 CSRP, locomotive emissions, will be derived from locomotive hours of operation, coupled with weighted emission rates that reflect a distribution of engine certification tiers and notch power settings. We will coordinate with the California Air Resources Board (CARB) to develop the specifics of those distributions for consistency with their ongoing locomotive inventory updates. After describing the scope of the analysis and the schema for reporting results, analysis methodology specifics for on-road emissions and locomotives will be discussed.

We will supplement these quantitative projections of emission changes with summary information regarding current rail-related emissions from CARB's Draft Technology Assessment: Freight Locomotives (April 2016). CSRP Chapter 6 will also reference and briefly discuss recent CARB documents and technology proposals that may influence air quality analysis in future CSRP updates.

1.0 Analysis Scope

Six Pollutants will be included in the air quality analysis:

- Carbon dioxide (CO_2);
- Reactive Organic Gases (ROG);
- Oxides of Nitrogen (NO_2);
- Carbon Monoxide (CO);
- Large Respirable Particles (PM_{10}); and
- Fine Particles ($PM_{2.5}$).

Emission changes will be calculated for 2022, 2027, 2040; and 2050[1] analysis years

[1] 2050 analysis will be done qualitatively, based on extrapolation of 2040 results.

On-road emission reduction benefits will only consider passenger vehicles. The consultant team assumes rail investments will not affect cargo amounts moving by commercial truck. From a programmatic perspective, we assume cargo suitable for freight rail transport will divert to an alternate port or business rather than change transportation modes.

The consultant team anticipates presenting passenger rail emission changes by the following geographic groups:

- Southern California (counties south of the Tehachapi Mountains);
- Central California (including the Bay Area, San Jaquan Valley, and Sacramento Region);
- Other California counties.

We also anticipate disaggregating freight rail emission into two groups representing Class 1 railroads and all other freight rail operators.

Table 1.1 provides a mockup of what we anticipate the results table will include. Emission reduction benefits from on-road passenger vehicles, passenger rail, and freight rail are combined to report the anticipated benefits accrued by each rail network element.

2.0 On-Road Emissions

The consultant team will base no-action on-road emission inventories for criteria pollutants on default results from the Emission Factors (EMFAC) 2014 emissions model. On-road GHG forecasts will be based on the fuel consumption projections produced by EMFAC 2014[2]. We will forecast on-road emission reduction benefits attributable to the 2018 CSRP using projected changes in VMT to scale emissions from the no-action alternative.

- The team will derive passenger vehicle VMT changes by air basin following the procedures outlined in Methodology Memorandum #5 (*Passenger Rail Ridership and Revenue Forecasting Process*). The passenger rail forecasts will identify VMT changes and to allocate those changes to the passenger rail network elements described in the prior section.

[2] Note that the California GHG inventory does not currently extend to 2050. GHG forecasts will be based on EMFAC 2014 fuel consumption and standardized emission rates per gallon of fuel used.

Table 1.1: Proposed Annual Statewide Emission Reduction Reporting Format

No-Action Emissions (Tons/Year)			Emission Reduction for 2018 California State Rail Plan Resulting From Changes in Locomotive and On-Road Vehicle Activity (Tons/Year)					
Year	On-Road	Rail	S California Passenger Service	N California Passenger Service	Other Passenger Service	Class 1 Railroads	Other Freight Rail Service	Total Change
Carbon Dioxide (CO_2)								
2022								
2027								
2040								
Reactive Organic Gases (ROG)								
2022								
2027								
2040								
Oxides of Nitrogen (NO_x)								
2022								
2027								
2040								
Carbon Monoxide								
2022								
2027								
2040								
Large Respirable Particles (PM_{10})								
2022								
2027								
2040								
Fine Particles ($PM_{2.5}$)								
2022								
2027								
2040								

- The passenger vehicle VMT changes will be used to scale emissions for the light-duty auto, light duty truck 1, light duty truck 2, medium duty vehicle, and motorcycle vehicle classes.
- Urban bus emissions will be scaled to reflect connecting bus service changes that are part of the 2018 CSRP, such as Amtrak Thruway buses.

This approach assumes that trip-end emissions scale proportionately to VMT, which is reasonable in this situation where VMT result mostly from mode shifts. Trip-end emissions include vehicle start emissions and evaporative emissions from the hot soaks after shutting off the engine. Diurnal and resting loss evaporative emissions will not be included in scaling of passenger vehicle emissions because, for purposes of this study, the regional passenger vehicle fleet's size is assumed to remain unchanged with the CSRP Vision Scenario.

3.0 Locomotive Emissions

3.1 Approach

The consultant team will forecast no-action locomotive emissions and projected locomotive emissions changes similarly to the on-road emissions, and consistent with CARB locomotive emissions inventory estimates. No action forecasts will be based the current locomotive emission inventory, extrapolated by a growth factor tied to projected locomotive activity. Control factors will be applied to account for the emission reduction benefits of electrification and for the reduction in criteria pollutants attributable to the uptake of Tier 4 locomotives by class 1 railroads and passenger services. We will apply emission rates from The Climate Registry[3] to forecast GHG emissions associated with increased electricity production for electrified portions of the system; we will scale the national emission rates to reflect implementation of California's Renewables Portfolio Standard. Criteria pollutant emissions associated with electricity generation will not be forecasts as additional electrical generation capacity is assumed to be located outside of the MTC region.

3.2 Locomotive Activity

The no action alternative will reflect locomotive activity levels consistent with the 2018 CSRP freight rail forecasts and assumed 2017 passenger rail services. The operating plans specified in the CSRP passenger rail forecasts and the projected activity levels on Class 1 and short line

[3] See for example: http://theclimateregistry.org/wp-content/uploads/2015/01/2013-Climate-Registry-Default-Emissions-Factors.pdf

railroads will inform the changes to locomotive hours of operation. Differences between the no action alternative and 2018 CSRP Vision Scenario will account for any changes in locomotive fleet or overall activity levels.

In general, duty cycles will be assumed to remain unchanged between analysis years and scenarios. However, benefits of some types of infrastructure investment, such as targeted capacity improvements to relieve congestion may be accounted for "off-model", potentially utilizing duty cycle, or similar, data.

3.3 Locomotive Emission Rates

Diesel locomotive engine power, and thus emissions, is controlled by "notched" throttles. Locomotive idling, braking, and movement occur by placing the throttle in one of several available notches, which in turn influence emissions. U.S. Environmental Protection Agency (USEPA) published default duty cycles (Table 3.1) in 1998 for different locomotive types[4]. We will use California-specific locomotive duty cycles data should they be reasonably available from CARB or industry stakeholders.

As part of U.C. Berkeley's Rail Economic Study being led by Mark Hansen, he has agreed to work with CARB to review proprietary CARB data that includes locomotive duty cycles. Dr. Hansen's team will identify if regional variation in duty cycles can be derived, and provide updated locomotive duty cycles where appropriate.

The consultant team will base traction engine emission rates on USEPA estimates[5], which are not identical to the locomotive citification levels. There can be significant variability in in-use emission rates depending on ambient conditions, the locomotive age, and deterioration of the emission controls. The USEPA emission rates are shown in Tables 3.2 and 3.3.

Use of these emission rates requires that each throttle notch's power level be known. We will use default assumptions derived from USEPA data[6], and augmented with California specific data to the extent that it is reasonably available from CARB or industry participants.

[4] USEPA (1998) Locomotive Emission Standards regulatory support document, EPA-420-R-98-101.
[5] USEPA (2009) Emission Factors for Locomotives, EPA-420-F-09-025. April 2009.
[6] USEPA (1998) Locomotive Emission Standards regulatory support document, EPA-420-R-98-101.

Table 3.1 USEPA Estimated Locomotive Duty Cycles

Throttle Notch	Line-Haul	Passenger	Switch
Idle	38%	47.4%	59.8%
Dynamic Brake	12.5%	6.2%	0%
1	6.5%	7%	12.4%
2	6.5%	5.1%	12.3%
3	5.2%	5.7%	5.8%
4	4.4%	4.7%	3.6%
5	3.8%	4%	3.6%
6	3.9%	2.9%	1.5%
7	3.0%	1.4%	0.2%
8	16.2%	15.6%	0.8%

Table 3.2 USEPA Line-Haul Freight and Passenger Locomotive Emission Factors

Emissions Standard	Manufacture Year	PM_{10} (g/bhp-hr)	$PM_{2.5}$ (g/bhp-hr)	ROG (g/bhp-hr)	NO_x (g/bhp-hr)	CO (g/bhp-hr)
Uncontrolled	Pre 1973	0.32	0.310	0.48	13.00	1.28
Tier 0	1973-2001	0.32	0.310	0.48	8.60	1.28
Tier 0+	2008+	0.20	0.194	0.30	7.20	1.28
Tier 1	2002-2004	0.32	0.310	0.47	6.70	1.28
Tier 1+	2008+	0.20	0.194	0.29	6.70	1.28
Tier 2	2005	0.18	0.175	0.26	4.95	1.28
Tier 2+ & Tier 3	2008 + & 2012-14	0.08	0.078	0.13	4.95	1.28
Tier 4	2015+	0.015	0.015	0.04	1.00	1.28

Table 3.3 USEPA Switcher Locomotive Emission Factors

Emissions Standard	Manufacture Year	PM_{10} (g/bhp-hr)	$PM_{2.5}$ (g/bhp-hr)	ROG (g/bhp-hr)	NO_x (g/bhp-hr)	CO (g/bhp-hr)
Uncontrolled	Pre 1973	0.44	0.427	1.01	17.40	1.83
Tier 0	1973-2001	0.44	0.223	1.01	12.60	1.83
Tier 0+	2008+	0.23	0.417	0.57	10.60	1.83
Tier 1	2002-2004	0.43	0.223	1.01	9.90	1.83
Tier 1+	2008+	0.23	0.184	0.57	9.90	1.83
Tier 2	2005	0.19	0.107	0.51	7.30	1.83
Tier 2+ & Tier 3	2008 + & 2012-14	0.11	0.078	0.26	7.30	1.83
Tier 4	2015+	0.08	0.015	0.26	4.50	1.83

We will forecast CO2 emissions based on fuel consumption, which will be determined from the following brake horsepower-hour per gallon (bhp-hr/gal) conversion factors[7]:

- Large line-haul and Passenger: 20.8 bhp-hr/gal;
- Small line-haul: 18.2 bhp-hr/gal; and
- Switching: 15.2 bhp-hr/gal.

4.0 Locomotive Fleet Distribution by Tier

CARB has published Class 1 locomotive fleet data in the South Coast Air Basin (Table 4.1)[8]. The Bureau of Transportation Statistics (BTS) publishes similar American Association of Railroads national locomotive fleet data (Table 4.2)[9]. We will combine data from these two tables with

[7] USEPA (2009) Emission Factors for Locomotives, EPA-420-F-09-025. April 2009.
[8] CARB (2015) 1998 Locomotive NOx Fleet Average Emissions Agreement in the South Coast Air Basin, http://www.arb.ca.gov/railyard/1998agree/1998agree.htm.
[9] "Association of American Railroads, Railroad Facts (Washington, DC: Annual Issues) p. 52 and similar pages in earlier editions" as cited by BTS:

locomotive survival rates to forecast future year tier distributions analysis. We will use an average of national and South Coast fleet data for areas outside of the South Coast Air Basin.

Mark Hansen has agreed to coordinate with CARB to develop the existing distribution of Locomotive certification tiers through their Rail Economic Study, which is a companion and supporting effort to the CSRP. Dr. Hansen's team will work with the South Coast and BTS data, plus proprietary data held by CARB to develop these distributions for the major elements of the rail system for which emissions will be reported. T. Kear Transportation Planning and Management will estimate how those distributions change over time using survival rate data published by USEPA.

Table 4.1 South Coast Class 1 Locomotive Fleet in 2014

Tier	Number of Locomotives	Megawatt-Hours (MWhrs)	%MWhrs by Tier Level
BNSF Railway			
Uncontrolled	78	220	0.1%
Tier 0	372	9,459	4.7%
Tier 1	1,128	50,382	25.3%
Tier 2	1,145	107,503	53.9%
Tier 3	576	31,832	16.0%
Total	3,299	199,396	100.0%
Union Pacific Railroad			
Uncontrolled	82	624	0.3%
Tier 0	2,699	62,605	29.4%
Tier 1	1,805	30,671	14.4%
Tier 2	1,758	78,119	36.7%
Tier 3	636	32,040	15.1%
Tier 4	2	78	0.0%
ULEL	61	8,476	4.0%
Total	7,043	212,613	100.0%

http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_01_32.html.

Table 4.2 BTS Class 1 National Fleet Data

Year Built[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total	18,835	18,344	18,004	18,161	18,505	18,812	19,269	19,684	20,261	20,256	20,028	19,745	20,506
<1970	5,117	4,353	4,038	3,766	3,535	[b]	[b]	[b]	[b]	[b]	[f]	[f]	[f]
1970-74	3,852	3,617	3,384	3,248	3,184	6,048[c]	5,783[c]	5,529[c]	5,565[c]	5196[c]	[f]	[f]	[f]
1975-79	4,432	4,375	4,292	4,352	4,275	4,254	4,274	4,219	4,116	4,000	8,541[g]	7,862[g]	7,133[g]
1980-84	2,837	2,826	2,784	2,730	2,625	2,754	2,735	2,728	2,723	2,581	2,411	2,153	1,790
1985-89	1,989	1,985	1,970	1,968	1,971	1,890	1,866	1,829	1,830	1,779	1,775	1,672	1,807
1990	608	605	604	604	599	2,965[d]	2,959[d]	2,958[d]	2,736[d]	2,688[d]	2,648[d]	2,667[d]	2,702[d]
1991		583	595	595	594	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
1992			337	340	339	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
1993				558	602	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
1994					781	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
1995						901	945	983	953	951	973	4,020[h]	4,582[h]
1996							707	696	708	706	697	[i]	[i]
1997								742	741	743	745	[i]	[i]
1998									889	890	890	[i]	[i]
1999										722	713	[i]	[i]
2000											635	691	987
2001												680	810
2002													695
2003													
2004													
2005													
2006													

Year Built[a]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2007													
2008													
2009													
2010													
2011													
2012													
2013													

Table Notes

a: Disregards year of rebuilding.
b: Included in 1970-74 category.
c: Includes all locomotives built before 1975.
d: Includes locomotives built between 1990-94.
e: Included in 1990 category.
f: Included in 1975-79 category.
g: Includes all locomotives built before 1980.
h: Includes locomotives built between 1995-99.
i: Included in 1995 category.
j: Included in 1980-84 category.
K : Includes all locomotives built before 1985.
l: Includes locomotives built between 2000-04.
m: Included in 2000 category.
n: Included in 1990 category.
o: Includes all locomotives built before 1990.
p: Includes locomotives built between 2005-09.
q: Included in 2005 category.

Table 4.3 BTS Class 1 National Fleet Data (continued)

Year Built[a]	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total	20,774	22,015	22,779	23,732	24,143	24,003	24,045	23,893	24,250	24,707	25,033
<1970	[f]	[f]	[j]	[j]	[j]	[j]	[j]	[n]	[n]	[n]	[n]
1970-74	[f]	[f]	[j]	[j]	[j]	[j]	[j]	[n]	[n]	[n]	[N]
1975-79	6,889[g]	7,056[g]	[j]	[j]	[j]	[j]	[j]	[n]	[n]	[n]	[n]
1980-84	1,655	1,585	8,705[k]	8,237[k]	7,907[k]	7,297[k]	7,054[k]	[n]	[n]	[n]	[n]
1985-89	1,791	1,799	1,786	1,735	1,695	1,604	1,558	8,420[o]	8,304[o]	8,145[o]	7,901[o]
1990	2,700[d]	2,715[d]	2,783[d]	2,740[d]	2,718[d]	2,494[d]	2,464[d]	2,384[d]	2,365[d]	2,368[d]	2,363[d]
1991	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
1992	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
1993	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
1994	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]	[e]
1995	4,673[h]	4,672[h]	4,348[h]	4,535[h]	4,300[h]	4,146[h]	4,173[h]	4,467[h]	4,461[h]	4,411[h]	4,382[h]
1996	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]
1997	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]
1998	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]
1999	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]	[i]
2000	863	863	[l]4,350	[l]4,673	[l]4,618	[l]4,777	[l]4,650	[l]4,265	[l]4,268	[l]4,262	[l]4,258
2001	891	891	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
2002	725	722	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
2003	587	591	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
2004		1,121	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
2005			807	881	876	876	875	[p]4,098	[p]4,091	[p]4,087	[p]4,039
2006				931	1,097	1,145	1,122	[q]	[q]	[q]	[q]

Year Built[a]	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2007					932	907	911	[q]	[q]	[q]	[q]
2008						757	777	[q]	[q]	[q]	[q]
2009							461	[q]	[q]	[q]	[q]
2010								259	256	256	253
2011									503	498	495
2012										683	693
2013											649

Table Notes

a: Disregards year of rebuilding.
b: Included in 1970-74 category.
c: Includes all locomotives built before 1975.
d: Includes locomotives built between 1990-94.
e: Included in 1990 category.
f: Included in 1975-79 category.
g: Includes all locomotives built before 1980.
h: Includes locomotives built between 1995-99.
i: Included in 1995 category.
j: Included in 1980-84 category.
K: Includes all locomotives built before 1985.
l: Includes locomotives built between 2000-04.
m: Included in 2000 category.
n: Included in 1990 category.
o: Includes all locomotives built before 1990.
p: Includes locomotives built between 2005-09.
q: Included in 2005 category.

Appendix A.11 Economic Benefits

These tables represent the California State Rail Plan, including **all** projects. They should be analyzed in the same manner as those in the previous report.

Findings:

In Table A.32: Direct Expenditures for All California State Rail Plan Projects (000s, $2018) below we report the direct construction expenditures associated with California State Rail projects as an aggregate, all in constant $2018 values. By 2040 these projects are expected to total just over $181 billion.

Table A.32: Direct Expenditures for All California State Rail Plan Projects (000s, $2018)

Direct Expenditure	2022	2027	2040	Total
Total by Period	$ 28,498,345	$ 77,659,538	$ 75,212,582	$ 181,370,465

As shown, the direct expenditures associated with the California State Rail Plan result in total output for the California economy of over $344 billion – a multiplier effect of 1.9[17]. Resulting in a total employment impact across affected industries of over 2 million person-years of employment, and labor income of over $126 billion.

The IMPLAN model also calculates tax revenues associated with this economic activity, in terms of State and local and Federal taxes. The tax impacts here are for taxes for which revenues can be directly inferred from economic expenditures, such as sales or income taxes.

The total tax revenues anticipated from the expenditures are close to **$9 billion** for State and local and close to **$24 billion** for Federal taxes by 2040.

[17] Total output includes the initial direct expenditures. It also includes all labor income in terms of wages and salaries.

Table A.33: Total Economic Impacts: Employment, Income, and Total Expenditures (000s, $2018)

Impact Summary	2022	2027	2040	Total
Direct Expenditure Impacts (A):				
Employment (Person Years)	$ 180,656	$ 492,298	$ 476,786	$ 1,149,740
Labor Income ($)	$ 11,154,666	$ 30,397,070	$ 29,439,296	$ 70,991,032
Output ($)	$ 28,478,301	$ 77,604,918	$ 75,159,683	$ 181,242,902
Indirect Expenditure Impacts (B):				
Employment (Person Years)	$ 57,498	$ 156,685	$ 151,748	$ 365,931
Labor Income ($)	$ 3,990,015	$ 10,873,007	$ 10,530,412	$ 25,393,434
Output ($)	$ 11,972,622	$ 32,626,045	$ 31,598,038	$ 76,196,705
Induced Expenditure Impacts (C):				
Employment (Person Years)	$ 85,342	$ 232,561	$ 225,234	$ 543,137
Labor Income ($)	$ 4,655,404	$ 12,686,230	$ 12,286,502	$ 29,628,136
Output ($)	$ 13,679,629	$ 37,277,732	$ 36,103,157	$ 87,060,518
Total Impacts (A + B + C):				
Employment (Person Years)	$ 323,496	$ 881,544	$ 853,768	$ 2,058,808
Labor Income ($)	$ 19,800,085	$ 53,956,307	$ 52,256,210	$ 126,012,602
Output ($)	$ 54,130,552	$ 147,508,695	$ 142,860,878	$ 344,500,125

Table A.34: Tax Revenue Impacts (000s, $2018)

Tax Summary	2022	2027	2040	Total
State and Local				
Sales Tax	$ 679,895	$ 1,852,751	$ 1,794,373	$ 4,327,019
Income Tax	$ 640,383	$ 1,745,079	$ 1,690,094	$ 4,075,556
Social Security	$ 49,245	$ 134,195	$ 129,966	$ 313,406
Total	$ 1,369,523	$ 3,732,025	$ 3,614,433	$ 8,715,981
Federal				
Excise Taxes	$ 124,297	$ 338,715	$ 328,043	$ 791,055
Income Tax	$ 1,812,387	$ 4,938,852	$ 4,783,235	$ 11,534,474
Social Security	$ 1,822,988	$ 4,967,742	$ 4,811,214	$ 11,601,944
Total	$ 3,759,672	$ 10,245,309	$ 9,922,492	$ 23,927,473

Appendix A.12 Program Effects Methodology

Appendix A.12
Program Effects Methodology

List of Acronyms

AB	Assembly Bill
Caltrans	California Department of Transportation
CSRP	California State Rail Plan
CTP	California Transportation Plan
FRA	Federal Railroad Administration
GHG	Greenhouse Gas
HSR	California High-Speed Rail
R&R	Ridership and Revenue
RTP	Regional Transportation Plan
PTC	Positive Train Control
SCS	Sustainable Communities Strategy
TCIF	Trade Corridors Improvement Fund
TREDIS	Transportation Economic Development Impact System
UC	University of California
VMT	Vehicle Miles Traveled

1.0 Introduction

The program effects analysis will guide content development for California State Rail Plan (CSRP) Chapter 6.2. The project team expects that the program effects analysis will include both quantitative and qualitative elements analyzed at state and regional levels. Should substantial changes to the described methods be required to implement the approach or meet the Scope of Work, the AECOM team will discuss the circumstances with Caltrans and document the final methodology in the Task 7 Procedural Manual.

The consultant team's overall program effects approach builds upon techniques used in the 2013 CSRP. The team will update the prior information to reflect the 2018 CSRP Vision and new analysis results. We will also expand topical coverage to address all Federal Rail Administration (FRA) and Assembly Bill (AB) 528 requirements. Table 1 illustrates where our proposed methods for addressing each AB 528 and FRA requirement can be found in this methodology memorandum.

We recommend analyzing and reporting these effects at the regional and/or system level for both the 4-year program and 20-year vision. Unlike highway project analysis, it is very difficult to isolate the effects of most individual rail capital projects or services. This difficulty stems from rail scheduling and dispatching's strong performance influence, and the substantially different performance characteristics of passenger and freight rail consists. In many cases, an individual capital project may not create a meaningful performance effect unless it is accompanied by a service change (which itself often requires additional capital projects to be feasible).

The 2013 CSRP included qualitative analyses of climate change and sea level rise, land use and community effects, and other benefits and policy support. The consultant team proposes to refresh this information using new or newly updated Regional Transportation Plan (RTP)/Sustainable Communities Strategy (SCS) plans approved since 2013, ongoing climate adaptation studies, California High-Speed Rail (HSR) environmental studies, and regional goods movement studies. We also recommend giving special attention to AB 528's requirement to discuss freight-related environmental impacts including air quality, land use, and community impacts.

The quantitative and qualitative passenger and freight rail program effects analyses will rely largely upon ridership and revenue (R&R) and freight forecast results; the R&R forecasting methodology is described in Methodology Memorandum #5. As with the R&R forecasts, Network Integration Strategic Service Plan program effects will be based upon the final 2022, 2027, and 2040 Vision Scenario developed in the Network Integration Strategic Service Plan, as described in Methodology Memorandum #2.

Table 1 Program Effects Analysis Requirements

Statutory Reference	Requirement	Methodology Memorandum Section(s)
Cal. Code § 14036(b)(6)(A)	"A freight rail element that contains … [e]nvironmental impacts that include air quality…"	6.0
Cal. Code § 14036(b)(6)(A)	"A freight rail element that contains … [e]nvironmental impacts that include …, land use, and community impacts."	7.0
FRA Guidance Section 5.4.1	"…the effects of the passenger and freight rail elements on… [t]he State's transportation system"	2.0
FRA Guidance Section 5.4.2 49 U.S.C. §§ 22705(b)(2)(A) and (B)	"…the effects of the passenger and freight rail elements on … [p]ublic and private benefits that exist and are anticipated with the 4 year phase and full 20-year plan and the correlation between public funding contributions and the expected public benefits."	3.0 and 4.0
FRA Guidance Section 5.4.3 49 U.S.C. § 22705(b)(3)(B)	"…the effects of the passenger and freight rail elements on… [r]ail capacity and congestion by corridor."	See Methodology Memorandum #7
FRA Guidance Section 5.4.4 49 U.S.C. § 22705(b)(3)(C)	"…the effects of the passenger and freight rail elements on… [t]ransportation system capacity, congestion, safety, and resiliency including the individual and combined effects on local transit, highway, aviation, and maritime modes.	2.0
FRA Guidance Section 5.4.5 49 U.S.C. §§ 22705(b)(3)(E) and (F)	"…the effects of the passenger and freight rail elements on… {e}nvironmental, economic, and employment conditions…"	3.0, 4.0, 6.0, and 7.0
FRA Guidance Section 5.4.5	"…the effects of the passenger and freight rail elements on… energy consumption and greenhouse gas emissions."	6.0

Statutory Reference	Requirement	Methodology Memorandum Section(s)
FRA Guidance Section 5.4.6 49 U.S.C. § 22705(b)(3)(D)	"…the effects of the passenger and freight rail elements on… [d]istribution of benefits to regions (regional balance)."	1.0
FRA Guidance Section 5.5.4, Passenger Element (49 U.S.C. § 22705(b)(2)(B))	"Describe the public and private economic benefits that exist and are anticipated with the 4 and 20-year plans and the correlation between public funding contributions and the expected public benefits."	3.0
FRA Guidance Section 5.6.2, Freight Element (49 U.S.C. § 22705(b)(2)(B))	"Describe the public and private economic effects that exist and are anticipated with the 4 and 20-year plans and the correlation between public funding contributions and the expected public benefits."	4.0

2.0 Transportation Performance Effects

The 2013 CSRP included a robust analysis of statewide and corridor-level transportation system effects. Chapter 10 of the 2013 Plan primarily used vehicle miles traveled (VMT) reduction resulting from the transfer of auto traffic to passenger rail to calculate passenger program effects. The project team will update this information, potentially at a more fine-grained level, using R&R forecasts developed for the 2018 CSRP. The R&R forecasting process will provide a tool for calculating the change in VMT and vehicle hours traveled, and modal diversion (for rail, highway and air travel) as passenger rail service is expanded.

Modal diversion from truck to rail is the primary effect relevant for freight rail programs. The economics and system performance characteristics of freight rail vs. trucking generally favor rail for specific commodities and long haul movements; the opportunities for diversion from trucking are somewhat limited. However, changes in fuel costs and congestion levels could impact the distances at which rail and truck are more competitive. The 2018 CSRP will examine, at the corridor level, the degree to which rail shares by O-D pair and commodity type are comparable to both statewide and national averages to identify opportunities where improving service levels can result in modal diversion. The project team will develop simple estimates of potential reductions in truck VMT as appropriate. Additionally, some regional plans, such as the San Joaquin Valley and Southern California Association of Governments, and prior Trade Corridors Improvement Fund (TCIF) project analyses have included specific corridor estimates. The team will utilize these to determine potential modal diversion.

3.0 Passenger Rail Economic Effects

The project team can readily quantify economic effects for the 2018 CSRP despite not including this analysis in the 2013 CSRP. Both the California Transportation Plan (CTP) 2040 and HSR project included economic analyses. We will first look to adapt these existing results for the 2018 CSRP. If additional economic modeling analysis is warranted, the project team suggests considering the Transportation Economic Development Impact System (TREDIS) because this model was used for the CTP 2040 and Caltrans may be procuring a new statewide TREDIS license. The HSR growth inducement analysis also used this TREDIS model, and Cambridge Systematics developed postprocessors to automate transfer of HSR R&R model results into the TREDIS model.

Additionally, researchers at the University of California (UC) at Berkeley and Irvine will be conducting the Rail Economic Study as part of a Task Order under Agreement 65A0529. This task will consider, qualitatively, how the State's demographic and economic trends may change rail's future. Factors to be considered include population and income growth in rail corridors, changes in the State's industrial mix, impacts of the aging of the population, and changes in fuel prices. The researchers will use propensity matching (i.e. comparing population/employment in places where rail service continued vs. in areas where rail service was discontinued) at the county level to examine passenger rail provision's impacts on development. The team will also investigate the enhanced value of real estate near rail stations. Methods developed in the Berkeley research project may also be used for Chapter 6.2.

4.0 Freight Rail Economic Effects

The consultant team proposes enhancing the qualitative freight benefits analysis by drawing heavily, where possible, from benefits analyses conducted for the TCIF program and RTP/SCS projects. Some local-level benefits analyses may be transferrable to the State level for a program-level benefits assessment. For example, the Southern California Association of Governments Comprehensive Regional Goods Movement Study analyzed the benefits of mainline track improvements using the REMI model. This analysis estimated the capacity limitations of current track, the amount of international trade cargo that would not be accommodated if additional capacity was not added, and losses to the state and regional economy (by assuming this cargo would need to divert to other ports).

The project team can use similar approaches to estimate potential rail-to-truck cargo diversion if investments are not made, how much this might cost shippers, and what additional highway maintenance costs would be incurred. UC researchers may also incorporate these approaches for freight rail in the Rail Economic Study, although without the use of economic impact models (basing more on corridor case studies). The CSRP team will work with UC researchers to determine which if any of these approaches can be incorporated in their work and transferred, as appropriate, to the program effects analysis for the 2018 CSRP. We will also consider other methods for freight rail analysis developed for the UC study in preparing the economic program effects of freight rail.

5.0 Safety Effects

While the CSRP will detail rail transportation's role in supporting and growing the state economy, it will also examine potential adverse impacts to adjacent communities. As traffic volumes grow, it is likely that community concerns—such as safety, noise, and air quality—will also grow.

While the study team does not plan to conduct an independent safety analysis, we will discuss the programs that are intended to support rail safety in California. These programs include Positive Train Control (PTC) and rail grade safety. Our examination of safety program effects will provide an update on PTC implementation status and requirements authorized by Congress in December 2015. We will present, in summary fashion, PTC implementation status in California. We will also discuss current policies and efforts aimed at improving rail grade safety, and will include historical safety information in the CSRP chapters relating to the Passenger Rail Investment and Improvement Act of 2008 (Section 207), and AB 528.

There are also potential safety effects specifically associated with freight rail. Chapter 1.2 of the CSRP will discuss safety impacts including the benefit of freight rail compared to freight on public highways. The study team will build this analysis off the aforementioned modal diversion analysis. We will also discuss freight railroads' PTC implementation on all lines handling regularly scheduled passenger trains and/or toxic inhalation hazard materials, as mandated by the Rail Safety Improvement Act of 2008.

6.0 Air and Noise Emission Effects

While freight and passenger rail projects can bring significant positive environmental and economic benefits to the State, they can also negatively impact communities and the natural environment. The most common effects include contribution to air pollution and greenhouse gas (GHG) emissions and physical impacts such as noise pollution.

The air quality and GHG analysis, which will be led by Dr. Thomas Kear, is detailed in Methodology Memorandum #8.

Noise pollution, which is described by the U.S. Environmental Protection Agency as "unwanted or disturbing sound," can contribute to significant public health impacts. Train horns must be utilized, by law, as trains approach at-grade crossings to warn motorists and pedestrians. There are currently 43 such quiet zone locations in California.[1] Grade separations also provide noise pollution co-benefits in addition to safety improvements, which we plan to examine. Our noise pollution program effects analysis will also include a qualitative discussion of actions intended to address rail-related noise. We will reference regional plans and possibly the California Air Resources Board's Sustainable Freight Plan for any noise-related information.

7.0 Community and Other Effects

The 2013 CSRP included qualitative analyses of climate change and sea level rise, land use and community effects, and other benefits and policy support. We propose to refresh this information using new or newly updated RTP/SCS plans approved since 2013, ongoing climate adaptation studies, HSR environmental studies, other Caltrans modal plans, the Sustainable Freight Action Plan, and regional goods movement studies.

Many land use and community effects are indirect and cumulative. For example, passenger rail ridership increases may generate demand for compact, mixed-use development near intercity passenger rail stations. Safe and efficient passenger rail services that are well-integrated with local transportation options may also contribute to community and greening benefits such as improved community livability, land use, safety, and public health. At the same time, increased rail operations can affect neighborhoods near rail lines, yards, and passenger stations. The study team plans to discuss issues around grade crossing impacts, Quiet Zones, and the impacts of land use assumptions associated with the new regional RTP/SCS plans. Some regional goods movement plans have recently raised these issues, but these may not have received sufficient

[1] Source: https://www.fra.dot.gov/eLib/Find#p1_z5_kquiet%20zone%20locations.

attention in the 2013 CSRP. We can address these issues in the 2018 CSRP by drawing heavily on such regional studies. We will also conduct a qualitative assessment of how, if at all, the CSRP might support land use visions in the latest RTP/SCS plans. This will include reviewing each SCS/RTP to identify opportunities for synergy between the passenger rail program and land use visions, such as plans for compact, mixed-use, transit-oriented development.

The UC Berkeley Rail Economic Study team at UC Berkeley is also qualitatively assessing real estate values near rail stations. The assessment may illuminate passenger rail's influence on real estate prices and development potential near stations, which is an important community effect that was minimally explored in the 2013 CSRP. The consultant team proposes incorporating the UC Berkeley findings, where possible, into the 2018 CSRP's community effects analysis.

Appendix A.13
Public Outreach and Stakeholder Involvement Details

Freight Meetings

Date	Freight Railroad	Type of Outreach
2/4/2016	California Freight Advisory Committee	In-person meeting
5/5/2016	Santa Maria Railroad	In-person Interview
5/6/2016	Pacific Harbor Lines	In-person Interview
5/11/2016	Pacific Sun Railroad	Phone Interview
5/19/2016	Central California Traction	Phone Interview
5/24/2016	Northwestern Pacific	Phone Interview
5/25/2016	Richmond Pacific	Phone Interview
5/27/2016	Modesto & Empire Traction	Phone Interview
6/8/2016	Sierra Northern	In-person Interview
6/8/2016	Sacramento Valley Railroad	In-person Interview
11/9/2016	BNSF	In-person briefing
8/17/2016	CA Short Line Railroad Association	In-person briefing
9/12/2016	California Freight Advisory Committee	In-person meeting
11/10/2016	CA Short Line Railroad Association	In-person briefing
11/14/2016	Union Pacific	In-person briefing

Network Integration Strategic Service Planning (NI SSP) Agency Meetings

Date	Agency	Type of Outreach
6/27/2016	Transportation Agency for Monterey County	In-person meetings
6/27/2016	San Luis Obispo Council of Governments	In-person meetings
6/27/2016	Santa Cruz County Regional Transportation Commission	In-person meetings
6/27/2016	San Benito Council of Governments	In-person meetings
6/28/2016	Caltrain	In-person meetings
6/28/2016	Metropolitan Transportation Commission	In-person meetings
7/6/2016	Southern California High Speed Rail Authority	In-person meetings
7/6/2016	LOSSAN Joint Powers Authority	In-person meetings
7/6/2016	Orange County Transportation Authority	In-person meetings
7/7/2016	Alameda County Transportation Commission	In-person meetings
7/7/2016	San Francisco County Transportation Authority	In-person meetings
7/7/2016	Valley Transportation Authority	In-person meetings
7/8/2016	Sacramento Area Council of Governments	In-person meetings
7/8/2016	Sacramento Regional Transit	In-person meetings
7/8/2016	Sonoma-Marin Area Rail Transit	In-person meetings
7/11/2016	Metrolink	In-person meetings
7/11/2016	Riverside County Transportation Commission	In-person meetings
7/12/2016	San Bernardino Association of Governments	In-person meetings
7/13/2016	San Diego Association of Governments	In-person meetings
7/13/2016	North County Transit District	In-person meetings
7/13/2016	San Diego Metropolitan Transit System	In-person meetings
7/14/2016	Southern California Association of Governments	In-person meetings
7/14/2016	California High-Speed Rail Authority	In-person meetings
7/15/2016	Santa Barbara County Association of Governments	In-person meetings
7/19/2016	Placer County Transportation Planning Agency	In-person meetings
8/1/2016	Transportation Agency for Monterey County	In-person meetings
8/9/2016	California High-Speed Rail Authority	In-person meetings

Date	Agency	Type of Outreach
8/10/2016	San Joaquin Joint Powers Authority	In-person meetings
8/17/2016	California Short Line Railroad Association	In-person meetings

Advocacy Meetings

Date	Organization	Type of Outreach
9/30/2016	The Nature Conservancy	In person meeting
11/14/2016	ClimatePlan Transportation Working Group	Phone meeting

Native American Tribes that Received Consultation

Date invitation letter sent December 28, 2016

Timeline of consultation January 2017 - May 2017

Date of request/response	Request format	Requesting tribe	District
Jan 1 2017	*Email/letter/call*	*Name*	#
1/4/2017	Email	Big Sandy Rancheria	6
1/12/2017	Email	Federated Indians of Graton Rancheria	4
1/10/2017	Email	Modoc Tribe of Oklahoma	2
1/17/2017	Email	Agua Caliente Band of Cahuilla	8
1/23/2017	Letter	Table Mountain Rancheria	6
3/2/2017	Letter	United Auburn Indian Community of the Auburn Rancheria	3

Public Survey Results

As part of the effort to develop the 2018 California State Rail Plan (Rail Plan), Caltrans released an early engagement survey in January 2016 seeking public input for inclusion. This summary report provides an overview of the survey results. The survey was available through the Caltrans website and distributed to an extensive rail plan mailing list; through organizations represented on the Rail Plan stakeholder advisory committee, and through press releases and Amtrak and Caltrans social media sites. The survey received a total of 2,189 responses between January 27 and March 4, 2016.

The goal of this survey was to obtain input from a large range of current and potential rail riders in California to help guide the Rail Plan which will present a vision for California's future passenger and freight rail network, and address strategies to achieve a modernized and integrated rail system. The Rail Plan fulfills state and federal rail plan requirements, and is an important element in the comprehensive examination of transportation investment strategies for the next 50 years.

Survey questions inquired about respondents' current usage of California rail, their opinions on the current state of California rail, and their highest priorities for improving California rail in the future. Additional optional demographic questions helped garner general information on respondents' affiliations, age, gender, income, race, and contact information to enter them into a raffle for a $50 Amtrak gift card. Five winners from across the State were randomly selected and contacted.

Survey Results

- The top reasons WHY current rail riders use rail: The top reason (more than 75%) were convenience and enjoyment of riding the train. Following that, respondents selected saving money, time, and safety as their top reasons for using the train.
- The TOP FIVE IMPROVEMENTS Caltrans should make to passenger train services were focused on a) serving more places / expand coverage; b) adding more trains per day; c) improving connections with local transit, bicycle, and pedestrian access; d) improving on-time performance and reliability; and e). making transfers between different trains easier and faster.
- The MOST IMPORTANT FREIGHT RAIL IMPROVEMENTS were listed as: a) separating freight from passenger lines and b) encouraging more use of freight rail for shipping to relieve roadway congestions.
- For SAFETY IMPROVEMENTS, an overwhelming majority of respondents believed the highest priority should be improving crossings with grade separations.
- WHY NOT the Train? The main factors selected as preventing respondents from choosing the train as a regular means of travel were a) trains not operating frequently enough; and b) trains not going where respondents want to go. (Less than 6% of respondents chose trains being too crowded or inadequate bicycle facilities as their reasons for not using the train regularly.)
- Top choices selected for how the rail network should SUPPORT ECONOMIC GROWTH were: a) providing more mobility choices for people to encourage economic activity, b) fostering transit oriented development, and c) reducing highway congestion.

Detailed Responses

The following provide a detailed breakdown of the responses received and a sample of additional write-in responses, where applicable.

What do you use or would like to use rail travel for? (Please select all that apply.)

Answer Options	Response Percent
Exploring the state/tourism	70.5%
Visiting family or friends	67.2%
Long distance travel	66.8%
Short distance travel	66.1%
Special events (e.g. attend a sporting event)	61.8%
Commuting	53.8%

Answer Options	Response Percent
Occasional business travel	51.8%

If you are a current rail passenger, which passenger rail systems have you been on? (Please select all that apply.)

Answer Options	Response Percent
Bay Area Rapid Transit (BART)	57.5%
Amtrak (AMTK) long distance services: California Zephyr, Coast Starlight, Southwest Chief, Sunset Limited	52.3%
Pacific Surfliner	38.9%
SF Muni Railway	38.1%
Caltrain	36.2%
Los Angeles County Metro Rail	36.1%
Metrolink	35.9%
Capitol Corridor	33.1%
San Diego Trolley	29.3%
San Joaquin	20.5%
Coaster	19.9%
Sacramento Regional Transit District Light rail	19.9%
Santa Clara Valley Transportation Authority light rail	16.4%
Sprinter	10.3%
Other (please specify)	6.3%
Altamont Corridor Express	4.5%

If you are a current rail passenger, why do you use rail? What do you use or want to use rail travel for? (Please select all that apply.)

Answer Options	Response Percent
Convenience – it allows me to enjoy my time while travelling (working, sleeping, reading, talking)	81.6%
I enjoy riding the train	75.5%
Cheaper than car (if adding all costs of gas, time lost and parking)	44.1%
It's safer than driving	41.5%
It saves me time (faster than driving when considering door to door travel time)	38.7%
I can transport my bicycle	20.2%
Other (please specify)	16.4%
I don't have a car/other personal transportation	9.5%
I don't have a driver's license	3.9%

Additional write-in responses:

- Lower stress than driving
- Climate Crisis requires us to emit less GHG
- Unlike bus or airplane modes, passenger rail allows me to change cars during the trip. This increases comfort: stretch legs, get away from noisy passengers, find car with cooler or warmer climate.
- Better for the environment

Please rate your current rail transportation options in California based on your level of agreement with this statement: "Rail gets me where I want to go in a timely manner with minimal inconvenience"?

Answer Options	Response Percent
Agree	27.0%
Disagree	24.8%
Neutral	24.4%
Strongly disagree	13.9%
Strongly Agree	6.4%
No opinion	3.6%

What are the most important improvements that that you think Caltrans should make to passenger train services in California (high-speed, intercity and commuter)? Please select your top 5.

Answer Options	Response Percent
Serve more places (expanding coverage)	70.6%
More trains per day	61.1%
Improve connections with local transit services, bicycle and pedestrian access	53.0%
Improving on-time performance and reliability	45.9%
Easier/faster transfers between different trains	33.1%
Reducing ticket costs	30.9%
Improving stations (e.g., shops, cleanliness, security, and open restrooms, more parking)	28.2%
Improving amenities on-board trains (dining and café cars, restrooms, seats and tables, bicycle racks, etc.)	20.7%
Easier ticketing and fare collection across the state	18.8%

Answer Options	Response Percent
Other (please specify)	16.4%
Using cleaner fuel for less pollution from trains	15.4%
Reduce noise produced by trains in communities	6.0%

What are the most important improvements that that you think Caltrans should make to passenger train services in California (high-speed, intercity and commuter)? Please select your top 5.

Answer Options	Response Percent
Serve more places (expanding coverage)	70.6%
More trains per day	61.1%
Improve connections with local transit services, bicycle and pedestrian access	53.0%
Improving on-time performance and reliability	45.9%
Easier/faster transfers between different trains	33.1%
Reducing ticket costs	30.9%
Improving stations (e.g., shops, cleanliness, security, and open restrooms, more parking)	28.2%
Improving amenities on-board trains (dining and café cars, restrooms, seats and tables, bicycle racks, etc.)	20.7%
Easier ticketing and fare collection across the state	18.8%
Other (please specify)	16.4%
Using cleaner fuel for less pollution from trains	15.4%
Reduce noise produced by trains in communities	6.0%

Other comments:

- Passengers deserve priority over cargo on many lines as well as High Speed Rail within state and beyond
- Improved speed. Must compete with cars on speed.
- Make trains faster: Upgrade from 79 to 110mp wherever possible, build HSR.
- Adding security to prevent thefts and harassment Hyperloop!
- Longer hours of service (late-night)

What prevents you from choosing the train as a regular means of travel? Please choose all that apply.

Answer Options	Response Percent
Train schedules are not convenient/ don't operate often enough	51.2%
Trains don't go where I want to go	45.2%
There are no good connections from the train station to my destination	32.0%
No train station near where I live (more than 15- 20 minutes away)	31.8%
No easy public transportation connection to the train station from where I live	31.5%
Taking the train takes too long	31.1%
I would have to change trains/ buses	20.9%
It's too expensive	18.3%
Comment (please specify)	18.1%
It's not reliable	13.3%
Parking at train station is full when I need it	11.2%
Inadequate bicycle facilities	5.5%
It's too crowded	5.5%

Other comments:

- There is no parking at station, others are too expensive to park
- It's hard to do without my car at the destination
- Need direct link to major airports
- Harassment of women, profane music, loud music (LA Blue Line)

What do you think Caltrans' highest priority should be for investments to enhance rail safety?

Answer Options	Response Percent
Improve crossings with grade separations (e.g., build over- or under-crossings, sealed corridor) to allow trains to be faster while reducing the possibility of collisions with vehicles, pedestrians, bicyclists, etc.	72.0%
Improve the safety and security of train and transportation terminals (i.e. airports, shipping ports, etc.)	9.3%
Prepare for emergencies, response, and recovery for all modes of transportation from human and natural disasters	6.6%
Don't know	6.3%
Other (please specify)	5.9%

California's freight rail system is privately operated and provides many of the tracks utilized by public passenger trains. What do you think California's highest priority should be to improve its freight rail system?

Answer Options	Response Percent
Separate freight from passenger lines	36.4%
Encourage more use of freight rail for shipping to relieve congestion from trucks on roadways	22.0%
Grade separate rail freight lines within city limits to reduce traffic impacts through town	13.3%
Provide more freight rail lines to move trucks off of the highways	10.1%
Don't know	7.3%
Other (please specify)	4.9%
Reduce environmental pollution from trains	3.0%
Encourage local economies to reduce the need for transporting goods far distances	3.0%

How should the rail network support economic growth? Please select your top three.

Answer Options	Response Percent
Provide more mobility choices and better access for people to get to where they want to go to encourage economic activity (work, businesses, parks, shopping, sporting events)	74.3%
Foster transit oriented development near train stations (mixture of housing, office, retail and/or other amenities in a walkable neighborhood and located within a half-mile of public transportation)	55.3%
Reduce highway congestion	47.7%
Make train stations into destinations with shopping, housing and business districts	39.7%
Improve the efficiency of the freight system, get more freight to move by train rather than truck	34.8%
Contribute towards state and federal Air Quality Requirements	17.5%
Other (please specify)	6.1%
Don't know	1.6%

Respondent Demographics

INTEREST / ASSOCIATION	RESPONSE %
Current rail passenger	64.0%
Interested member of the California public	57.0%
Previous rail passenger	33.7%
Local or state government employee	21.9%
Potential rail passenger (never taken a train)	8.3%
Advocacy group/NGO	5.3%
Local, metropolitan or regional planning agency	4.1%
Community leader/or elected official	3.0%
Passenger rail operating agency	2.3%
Freight rail provider	1.5%
Transportation Industry representative	1.2%
Tribal Representative	0.5%
TIME SPENT COMMUTING PER WORKDAY	**RESPONSE %**
Less than 30 minutes	30.1%
30 minutes – 1 hour	27.3%
1-2 hours	19.5%
2-3 hours	6.4%
More than 3 hours	3.4%
Do not commute to work	13.2%
HOUSEHOLD INCOME	**RESPONSE %**
$0 to $9,999	1.7%
$10,000 to $24,999	3.7%
$25,000 to $49,999	9.8%
$50,000 to $74,999	14.0%
$75,000 to $99,999	14.6%
$100,000 to $124,999	16.5%
$125,000 to $149,999	7.1%
$150,000 to $174,999	7.5%
$175,000 to $199,999	3.8%
$200,000 and up	9.3%

AGE	RESPONSE %
Under 19	1.0%
20-24	4.9%
25-34	20.6%
35-44	17.9%
45-54	18.9%
55-59	12.7%
60-64	10.2%
65-74	9.3%
75 to 84	2.5%
85 years and older	0.3%
GENDER	**RESPONSE %**
Female	26.1%
Male	72.8%
RACE OR ETHNICITY	**RESPONSE %**
White or Caucasian	71.2%
Asian-American/Pacific Islander	8.6%
Spanish, Hispanic, or Latino	7.1%
Multiple ethnicities	4.4%
Black or African-American	2.8%
Native American /Alaska Native	1.8%
LANGUAGE SPOKEN AT HOME	**RESPONSE %**
English	97.8%
Spanish	3.0%
Chinese (Cantonese or Mandarin)	2.1%
Tagalog	0.9%
Other	2.3%

Conclusion

The more than 2,000 responses to the 2018 California State Rail Plan Survey helped shape the vision for the Draft Rail Plan. This vision will guide California's future passenger and freight rail network. According to responses to the survey, top priorities and themes include:

- To expand coverage and increase service for passenger rail. These were the top two priorities for improving passenger rail and the top two factors preventing people from using rail regularly. Additional priorities include: Improve transfers, connections with local transit, reliability and on-time-performance

- The majority of respondents choose rail because they enjoy riding the train, and the train is often cheaper than using a car
- They use or would like to use rail for a variety of different reasons, from leisure travel to commuting
- Highest priority for safety improvements are to improve crossings with grade separations